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INSTRUCTIONAL-CUM-PRACTICAL MANUAL
ON
LINEMAN PRACTICE
FOR
LINEMAN VOCATION CLASS-XI

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PREFACE

Ever since the introduction of Vocational Education in our school system by several States and Union Territories in our country, the paucity of appropriate instructional materials has been felt as one of the major constraints in implementation of the programme and a source of great hardship to pupils offering vocational studies at the higher secondary stage.

Deptt. of Vocationalisation of Education of the National Council of Educational Research and Training (NCERT), New Delhi has started a modest programme of developing instructional materials of diverse types to fill up this void in all major areas of Vocational Education. The task is too gigantic to be completed by any single agency but the model materials being developed by us might provide guidance and impetus to the authors and agencies desiring to contribute in this area. These are based on the national guidelines developed by a working group of experts constituted by NCERT. The present manual is on LINEMAN PRACTICE for Lineman Vocation Class XI. It contains practical exercises to be performed by the students with simple steps to follow, precautions to be taken and data to be observed and recorded in observation sheet. Each experiment is complete with specific objectives, theoretical information, behavioural outcome and questions for evaluation, etc. It is hoped that the students will find them immensely useful.

The pages that follow contain a draft of the manual which will be finalised after obtaining the feed back from the students, teachers and others concerned. The materials will then be published in printed form.

The users are requested to complete the questionnaire appended and return the same to us. Comments and suggestions for improvement of the material are cordially invited.

The material has been developed by a group of experts as authors in a Workshop held at the Technical Teachers' Training Institute, Chandigarh from 1 to 8 December, 1983. Their names are mentioned elsewhere and their contributions are admirably acknowledged. This material was edited and finalised by another group of experts at our Unit from 30 January to 2 February, 1984. Our thanks are also due to the experts for taking pain to veryfying the authenticity of contents of the manual. Shri Sachchidananda Ray, Lecturer in Technology deserves special thanks for editing and bringing the material in the present form. The assistance rendered by the staff members of CDC, TTTI, Chandigarh and D.V.E., NCERT for bringing ou this manual is also thankfully acknowledged.

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INTRODUCTION

The Vocationalization of higher secondary education in the 10+2 pattern of schooling has been introduced by several States and Union Territories in the country. The implementation of this programme received further encouragement by the Conference of Education Ministers in 1981. With the priorities laid down in the Sixth plan a few more states are seriously planning to switch over to 10+2+3 pattern of education and to implement Vocationalization at the plus two stage.

The implementation of the programme for the states and Union Territories has revealed that there is a great dearth of appropriate instructional materials. Since the Vocational Courses laid a great emphasis on practical training it has become necessary to prepare Instructional-cum-Practical Manuals best suited for those courses. The absence of appropriate instructional material has been one of the major constraints in the implementation of the programme and a source of great hardship to students offering Vocational studies at the plus two stage.

To develop models of instructional materials, the Unit constituted a Working Group to formulate guidelines for the development of instructional materials and to prepare brief examplar units. National guidelines were developed by this Working Group for preparation of instructional material.

The manual on Lineman Practice for Lineman Vocation class XI has been developed based on the guidelines reccommended by working Group. This manual is envisaged to help both teachers and students. Each experiment is complete with specific objective, introductory information and related theory, equipment and materials, diagram, procedure, record of observation, precaution and questions for evaluation. In order to acquaint the students about each experiment, the teacher should provide them with required theoretical knowledge or information related to the experiment. This will help the students for proper understanding of the experiment and enable them to perform the experiment properly and effectively.

In order to meet the stipulated objectives, the experiments include the study and operation of tools and instruments which a lineman would be required to use in his professional career, operation of machines, visit and study of Sub-station, Power-Station and Factory. It is believed that the time spent in the laboratory and the field study will help the students to acquire sufficient confidence to handle his job with diligence.

The evaluation of the experiments performed by the students shall be based on the specific objectives. The teacher shall evaluate all the aspects which are relevant to achieve the specific objectives. This will contribute towards the "expected behavioural outcome". Evaluation is an important aspect of performing the experiments. Each experiment should be assessed through evaluation based on knowledge, acquired skills and competencies, attitude and aptitude towards work, experiment performance, application, maintenance of experiment record. Tabular representation of suggested evaluation scheme is given below:

Sl. No.	Components	Marks allotted	Marks obtained
1.	Knowledge	20	
2.	Acquired skills and competencies	35	
3.	Attitude and Aptitude towards work	15	
4.	Experiment performance	10	
5.	Application	10	
6.	Maintenance of Experiment Record	10	
	TOTAL MARKS	100	

At the end of each experiment, some questions for evaluation are given. The students shall answer these questions after the completion of each experiment and teacher shall examine them. If required, necessary corrections and suitable suggestions should be incorporated by the teacher. However, the answer to these questions should not be considered for the purpose of awarding final grade or marks.

CONTENTS

Sl.No.	Title of Experiment/Practical	Page No.
1.	Study into Safety Manual	1
2.	Preparation of chart for safety slogans	4
3.	An Introduction to safety devices/tools	6
4.	Study of electric shock and burns and their remedial measures.	11
5.	Practice of giving shock treatment - Artificial Respiration	16
6.	First aid practices	23
7.	Use of fire fighting equipments	25
8.	Identification of parts/components of domestic supply line and industrial supply line.	27
9.	Practice of making test report of an electrical installation	32
10.	Connection of lamps and domestic appliances in series and prallel.	35
11.	Use of Phase tester and test lamp	39
12.	Making a series parallel testing board	43
13.	Control of one lamp from one point	46
14.	Control of one lamp from two points	48
15.	Control of one lamp from three points	50
16.	Making a Brittania joint	52
17.	Making a Western Union joint	55
18.	Making a T-joint	58
19.	Connection of A Fluorescent Tube with A.C. supply	61
20.	Marking of vertical and horizontal lines on the walls/board using plumb bob and thread	63
21.	Marking the position of T.W. Boards and Round Blocks on the wall	65
22.	Fixing of gitties by using a chisel & hammer	67
23.	Fixing of Rawl plugs and compound using Rawl tools and bits.	70
24.	Practice of marking Round blocks and boards for fixing of electrical accessories	72
25.	Practice of various boards and blocks	75

26. Fixing of Tumbler switches and Flush type switches or blocks and boards 77

27. Fixing of various Iron clad switches on board 80

28. Control of one lamp by one S.P.T. switch in cleat wiring 82

29. Control of two lamps in series by one switch in cleat wiring 85

30. Control of two lamps in parallel independently by two switches 88

31. Control of two lamps in parallel by one S.P.T. switch in cleat wiring 91

32. Practice of fixing of link clips on the batten as per the IS: specifications. 94

33. Practice of making various joints on teak wood battens 97

34. Cutting of Round blocks & boards to fix the batten. 99

35. One lamp controlled by one switch on T.W. batten in TRS/CTS/PVC wires 101

36. Control of one lamp from two different places - wiring on T.W. Battens (Stair casewiring). 105

37. Control of one lamp from 3 places with intermediate switch using T.W. battens and CTS/TRS/PVC cables. 109

38. Control of two lamps from 3 different places - using T.W. battens and CTS/TRS/PVC cables 113

39. Godown wiring for three points on T.W battens using PVC/TRS/ cables 117

40. Multi stair case Wiring for a 3 storey building on T.W. batten with CTS/TRS/PVC cables 122

41. Control of one lamp from 2 places and to provide 3 pin blug one main switch with fuse cut outs in a lighting circuit. 126

42. Control of one lamp from 2 Places and to provide a 3 pin socket and main switch and fuse cut outs in a power circuits. 132

43. Practice of cutting of a metal conduit and to thread correctly to suit the conduit accessories. 137

44. To prepare a conduit square using conduit accessories. 141

45. Practice of using earth wire & earth clips on metal conduits for lighting and power circuits. 144

46. Wiring of a domestic installation having 2 rooms in PVC conduits (surface wiring) [illegible]

47. Domestic installation wiring for a two room house in metal conduit (concealed wiring) [illegible]

48. Practice for [illegible] to position of poles and drilling of holes. [illegible]

49. Practice of digging of holes and erection of poles. [illegible]

50. Practice of fixing different fittings on poles such as C-arms, Insulators, Stay-wires, guy rods/wires [illegible]

51. Practice of testing the alignment of poles 179

52. Practice of stringing and sagging of overhead line conductors

53. Practice of jointing overhead line conductors. [illegible]

Appendix - I List of contributors [illegible]

Appendix - II Review and Editing Committee [illegible]

Appendix - III Questionnaries [illegible] opinion of [illegible] [illegible]

EXPERIMENT/PRACTICAL NO.1

TITLE OF EXPERIMENT/PRACTICAL

A study into Safety Manual.

SPECIFIC OBJECTIVES

1. To avoid danger to equipment and personnel working with electrical installations.
2. To give knowledge about the safety practices as prevailing in Safety code.
3. To give introduction about I.E.Rules.

INTRODUCTORY INFORMATION AND RELATED THEORY.

Safe operation of equipment and safety to personnel working should be uppermost in all considerations while operating, maintaining and repairing electrical installations and equipments. It is, therefore, necessary to formulate the safety procedures and practices to be followed in all major and minor electrical installations such as generating stations, transmission and distribution lines, industrial establishments etc. To make oneself conversant with the safety rules and regulations governing the work, it is necessary to acquaint with the following rules and regulations:

a) Indian Electricity Rules,1956.
b) Factories Act,1948.
c) Workmen's Compensation Act, 1923.
d) Payment of Wages Act,1936.

PROCEDURE

The following instructions should be issued and one should see that they are followed for safe working in Electrical works.

1. As a part of safety measure it is necessary that there shall be one competent person who will issue orders for energising or de-energising the lines. The permit to work certificate from the person incharge of operation to the person incharge of the men selected to work on lines, where, the [illegible] of the installation where the work is tobe carried out, [illegible]

dead for safe working. Such a procedure when followed strictly can avoid most of the electrical accidents.

2. Even after obtaining permit to work, it is necessary to use appropriate devices such as neon lamp indicators and testing rods to make sure that the lines are de-energised.

3. For safe working in Electrical works, follow the following instructions:

a) Place yourself in a safe and secure position to avoid slipping or moving backward against line conductors and equipment.

b) Warn others when they seem to be in danger near line conductors or apparatus.

c) Do not wear nailed shoes. Shoes with rubber soles are preferable.

d) All voltages are dangerous. It is necessary to note that even low voltage shock may be fatal.

4. Where the victim is in contact with live conductor or equipment, switch off current AT ONCE before removal of the victim. If this cannot be done and the victim is in contact with the low voltage appratus, pull him off by using rubber gloves, if handy, by his coat or shirt, or any other dry cloth bag or dry rope. If the victim is in contact with high voltage appratus, he shall be handled only with a H.V.operating rod or a piece of perfectly drywood or rope -care being taken to have at least 3 feet of wood or rope between the hands and the man on any live metal.

5. Do not wear loose clothing, metal watch straps, bangles or finger rings while working on electrical appratus. Do not hang clothes and such other things on electrical fittings

6. Examine before use all safety appliances, such as rubber gloves, mats, ladders, goggles, insulated pliers etc. for their soundness. Do not use a ladder without a lashing rope, otherwise the ladder should be held firmly by another person.

7. Danger notices, barriers and screws shall be fixed or moved only under the supervision of an authorised person.

8. Report all accidents, whether minor or major, non-fatal, immediately to the person-in-charge.

9. Preach and practice safety at all times.

Instructor should arrange audio visual aids or charts from FIRST AID/RED CROSS/ELECTRICAL AUTHORITIES to demonstrate use of safety practices.

Students should observe through films on safety measures to be arranged by their instructor/school.

QUESTIONS FOR EVALUATION

1. What are the sources of instructions in safety manual ?
2. Why safety procedures should be followed ?
3. How you will proceed to remove a person having met an accident and is in contact with live wire ?
4. What precautions should be observed regarding dress/clothes while on work ?

EXPERIMENT/PRACTICAL NO: [illegible]

TITLE OF EXPERIMENT/PRACTICAL

Preparation of chart for SAFETY slogans.

SPECIFIC OBJECTIVES

1. To highlight the importance of safety
2. To avoid accidents to workmen, public and consumers in public.
3. To avoid damages to electric equipment.

INTRODUCTORY INFORMATION AND RELATED THEORY

Life is short and precious. While working with electrical equipment it is absolutely essential that precautions be taken to avoid accidents. Employees of electrical undertakings and public in general needs to be educated and more safety cautious.

EQUIPMENT AND MATERIALS

Writing material

PROCEDURE

Following safety slogans be written on note book by the learner and a separate chart be got prepared and displayed in the workshop.

SAFETY SLOGANS.

1. Be safety minded.
2. Always be alert. Avoid accidents.
3. Safety requires careful working.
4. Time is important, but safety is far more important.
5. Little care makes mishaps rare.
6. Donot think it is safe, make sure.
7. Accidents begin where safety ends.
8. A danger foreseen is an accident prevented.
9. Eliminate all short-cuts, while on duty.
10. Constant vigil is the price for safety.
11. Where vigilance ends, accidents begin.
12. Donot trust luck, trust to safety.

13. Jokes begin in fun can end in tragedy.
14. Life is short and precious. Donot shorten it by carelessness.
15. Look before you leap.

SPECIAL NOTES

1. Safety slogans chart be prepared neatly.
2. Learners should study safety slogans carefully and be safety minded.

QUESTIONS FOR EVALUATION

1. Why safety is required ?
2. Name any three safety slogans.

EXPERIMENT/PRACTICAL NO: 3

TITLE OF EXPERIMENT/PRACTICAL

An introduction to Safety Devices/ Tools.

SPECIFIC OBJECTIVES

1. To impart know-how about the safety devices/tools available to lineman so that he may work in accident free manner.
2. To impart know how about maintaining the safety devices/ tools in proper condition.
3. To impart training about how to use these safety devices/ tools.

INTRODUCTORY INFORMATION AND RELATED THEORY

The majority of the accidents which occur at present are preventable. Roughly, causes of accident may be put into three classes: first, accidents resulting from lack of supervision or lack of knowledge; second, accidents resulting from personal carelessness; third, accidents resulting from the contributory negligence of others. It is essential that safety be considered and practiced in all departments at all times. A Lineman is called on to handle a great many jobs, each under a different condition (different poles, wire arrangement, installation of equipment and fixtures, etc). By using different safety devices/ tools, great benefits can be realized by linemen.

EQUIPMENT AND MATERIALS

1. Measuring rules e.g. Metal rules, metal measuring tapes.
2. Ropes forming yoke of deadmen.
3. Ladders.
4. Canvas tool bag containing screw drivers, insulated pliers etc.
5. Axes, saws, soldering equipment.
6. Rubber gloves, safety belts , etc.

PROCEDURE

Here, details have been given regarding few safety devices/ tools about their handling, use and maintenance:

1. ' Deadmen' Yoke

The yoke of the deadman should be maintained free from cracks and should be secured firmly to the top of the pole. Where the condition of any part of a deadman is such that cannot be maintained properly, new parts should be secured or the whole deadman should be scrapped and replaced.

2. Measuring Rules

Metal rules, metal measuring tapes should not be used on standing poles. Overhead measurements should be made by dry hand lines or dry wood molding. The actual length found by ' laying off' the line or molding may be measured on a tape or rule placed on the ground.

3. Ladders

Wooden ladders be used in preference to iron ladders. Ladders should be so placed that the horizontal distance from the point of support to the foot of the ladder shall not be less than 1/4th of the length of the ladder and not more than 1/2th of the length of the ladder. In using a ladder, a lineman should not attempt to reach sideways so far as to throw his weight off the ladder. Ladders must never be placed on slanting , oily, slippery, or icy footings unless they are securely fastened and protected to prevent slipping or twisting. Ladders must always be placed securely in position before they are put into use. Wherever practicable, ladder shoes should be used to prevent the possibility of ladder slipping.

4. Canvas Tool Bag

A canvas bag should be used for raising and lowering of all tools to and from the working position on the pole and for the storage of small tools at the working position. No metal should be used in making the bag. The handles of pliers, screw drivers and similar tools may be insulated.

5. Axes Saws, Soldering Equipment

The use of hand axes should be avoided in the line work. In those cases where axes cannot be eliminated (.e.g. tree cutting), they should be carried up and down the pole in tool bag.

Full-length saws should not be used among wires when there is possibility that line wires, taps, or services may be short circuited or grounded by them. Soldering tools should be kept on the ground except when actually in use on the pole. Solder pots which will not drip or throw solder to the ground should be used.

6. Belt Tools

Belt tools should be so secured that they will not be apt to fall from the tool belt. A lineman should carry only pliers, screw drivers, and connectors in his tool belt.

7. Rubber Gloves

Rubber gloves must be worn by a lineman while he is putting or removing portable protective insulation from line conductors and pole equipment, while making tests on high tension and low tension sides of transformers. While they are removing and replacing fuse cutouts on primary distribution circuits, while they are stringing wire near to line and live equipment exceeding 300 volts to ground.

Rubber gloves must not be worn for those ground jobs where the possibility of accidental contact with live wires and equipment does not exist; while lineman is climbing up or down the lower part of a pole below the lowest cross arm carrying supply lines, supply equipment etc.

A lineman should not put his rubber gloves into his coat or trousers pocket where there may be tools and line material. Gloves carried in this way are liable to injury. Rubber gloves must be stored at a place to be available at all times when the lineman needs them on the job.

At each job before a lineman puts on his rubber gloves he should test each glove, mechanically for cuts and weak spots by rolling it up tightly beginning at the gauntlet end, he should notice if any air escapes through the palm, the thumb, or the fingers of each glove. This is usually called the air test. Gloves which show weak spots or air leakage in this test should not be used for voltage protection. Rubber gloves should be subjected to an electrical breakdown test periodically and gloves which show defects in this test or which do not fully comply with the specifications should be replaced, with good gloves.

Rubber gloves should not be interchanged. Each lineman should have his own pair of gloves and that becomes defective be replaced with a new one.

9. Linemen's Belts

Each lineman authorised to climb should be equipped with a complete belt (body and safety belt), and he should use no other. Linemen's belts and safety belts shall not be used as slings for hoisting materials. In emergencies, as in cases of electric shock, dry hand lines may be attached to a lineman's belt and the belt used in connection with lowering him. Body and safety belts should be inspected carefully periodically for condition of leather, leather near the holes, rivets, stitches, buckles, Drings and snaps. Belts which are weak or defective in any respect should not be used. The leather of a lineman's belt should be treated occasionally with oil to keep it soft and reliable.

No more holes than are absolutely necessary should be cut or punched into a body belt. Holes weaken the leather. The attachment of metal parts to body belts should be avoided wherever possible. D-Rings should be placed so that they will be supported from the inside of the body belt. A lineman will then be less liable to fall in case the D-rings pull out.

Care must be taken by lineman in the attachment of snap to D-rings. Care must be taken that the D-ring is within the hook and that the keeper of the snap is closed fully before any weight is applied to the safety belt. After a safety belt is snapped in place, a lineman should test it, by carefully throwing the weight of his body against the safety to make sure that it is properly fastened before the undertakes any work. While this test is being made, the lineman should have his hands close to the pole or other support so that he may readily grasp the support in case the safety should pull out. This test should be made each time the safety belt is used in a new position.

Safety belts should be so secured that there will be no possibility that they will cutout by being accidentally pressed against line equipment. Safety belts should not be supported from insulator pins, insulators, line wires, or X-arms or transformer braces, to a pole close to a guy where the guy is furnished with pole plates or guy hooks; to pole steps.

When the safety belt is being put in place, care must be taken that it is not twisted and that it does not foul material which will give way when strain is applied. Snaps on safety belts should be closely inspected for defective and tight jaws and for weak or defective keeper springs. Snaps should also be inspected for cracks in the metal.

Observations:

Instructor should see that the trainee identify the safety tools described above and uses these in the manner already done and make his own diary report based on actual experience.

Precautions:

1. Inspection of rubber gloves and safety belts be done very carefully.
2. Periodical testing must be carried out for rubber gloves and safety belts.
3. To avoid accidents, safety tools/devices must be used.

Questions for evaluation:

1. What parts of a body belt and safety belt needs inspection periodically ?
2. How should the safety belt be tested? How often should this be done?
3. Where, at the working position, should the safety belt be secured?
4. When should rubber gloves be worn? be not worn?
5. Why are rubber gloves necessary?
6. How and when should rubber gloves be tested on the job?
7. What precautions would you take in handling ladders:
   (a) to prevent them from slipping -(b) to prevent them from falling?
8. What is the object of an insulated canvas tool bag and how it should be maintained?
9. Mention the care you will take in the use of solder?
10. What tools should be carried in the body belt?

EXPERIMENT/PRACTICAL NO: 4

TITLE OF EXPERIMENT/PRACTICAL:

Study of electric shocks and burns and their remedial measures.

SPECIFIC OBJECTIVES:

(a) State causes of electric shock and burns.
(b) State the situations in which possibility of getting shock by a person exists.
(c) Take measures to remove the person from the supply and disconnect circuit from supply.
(d) Understand general safety precautions.

INTRODUCTORY INFORMATION AND RELATED THEORY:

Electric supply used in day to day life in home and industry is either A.C. or D.C. A.C. supply in home and most of industries varies with time and completes 50 cycles per second. While in many industries equipment working on high frequencies are also in use.

When-ever human beings come in contact with live wires or metal casing of an electrical appliance or control equipment which has become live due to the failure of insulation between live conductor and metallic body, electric shock is experienced. Due to this contact, electric current flows through his body. (See Figure 1)

Figure 1 shows an electrical appliance whose metallic body is touching the element connected to supply. Due to this metallic body gets charged and acquire potential above earth. In case a human being touches the electrical appliance a current flow from appliance to the human body and to earth.

Electric current passing through the human being has different effect on him depending on the magnitude of current. Magnitude and severity of shock depends upon the magnitude and path of current flowing through the body, duration for which human being remain in contact with live wire and the types of supply.

The magnitude of current depends upon the potential and body resistance. Body resistance varies from individual to individual. This lies between 1 to 5 x 10^5 ohms when dry and may drop to 5000 ohms when wet. In case of live wire coming in contact with wet hand shock will be more severe than dry hand. The severity of shock depends also on the path of current. When current path lies through heart, the shock is more severe than when it passes over the skin. It is due to importance of the organ in the working of human body. Further if a person remain for longer duration in contact with live wire/ live part the effect of shock will be more severe.

A.C. and D.C. supply both give shocks. In A.C.victims get shocked in jerks due to frequency of the supply system. At zero position of the cycle the lucky persons get disengaged but in D.C. the current just keeps on flowing at its steady value, and person get no chance to disengage. That is how the statement has come to: 'DC just pull, the victim to death whereas the AC pulls and tries to throw the victim away.'

The major causes of electric shock to human beings are the result of following:

1. Accidental contact with live conductor/apparatus.
2. Accidental contact with a broken live conductor or the fall of live conductor on a human being.
3. Contact with an electric apparatus having leakage more than the specified limits.
4. In-experienced handling of electric supply line/appratu
5. Improper repairs of the house hold electric appliances
6. Intentional contact with live supply line/apparatus.

The electric shocks may spare lives but often they leave the victim with unfortunate dis-abilities visible or obscure. Very often persons get their muscles switched to their very death and yet crippled. Burns leave ghastly scars and twisted limbs. Burnt and scorched skins and flesh seldom repair. The unfortunate victim never becomes his ownself in appearance or his physical ability. He survives, if at all he survives, only to live a life of a crippled or a handicapped. Plastic surgery does come to help but the recovery takes a long time. In electric shocks burns are invarably present. Higher the voltage severer are the burns. Body skin and flesh cells are burnt to death. Local applications of medicines do not help. This is a big loss of plasma (50% of blood is made of plasma). Oral medicines are of no avail because of impaired circulation of blood due to its loss. Neither the injections help the affected points due to less blood and poor circulation as stated above. Victims often recover from shocks and comes to. They appear good and cheerful too but gradually inspite of treatment, their conditions deteriorates and finally they scumbled to their burns and injuries within a period only from two to three days.

Inspite of what is said above, there are examples of recoveries. It all depends how the victim takes the accident and how whole heartelly the medical personnel take his care.

When a case of electric shock is observed first step to be taken is to free the victim of electric shock from the contact with live parts. If the switches are nearby, they should be immediately put off and the person removed to a safer place. If, however , the switches are not close by and if they are unknown to the first reaching person, he should make use of some insulating material as wood, dry cotton or other clothes, some good dry ropes etc., to pull the person away from the mains. If nothing is handy, the person could undo his clothes may be his coat or pant, a shirt or bushshirt and then with their help the person may be pulled apart, while pulling if possible he may stand on some dry wood. Conductor may be even cut by axe having large dry wooden handle. In case of high voltage supply, where it is not possible to break the contact of victim, it may become necessary to short circuit the live wires by throwing chain over them. This will cause short circuit which will trip off the line at the substation and thereby making the line dead.

For taking remedial action in treating a person affected by shock and burns, it will be necessary to understand what happens biologically to the person who sustains electric shock.

When a person gets electric shock, most often current passes through the breathing centre at the base of the brain and cause the centre to stop sending out the nervous impulses, which act upon the muscles, responsible for breathing. As a consequence breathing stops abruptly. If the shock has not been severe, after a time the breathing centre recovers and resumes the vitally necessary duty, of sending impulses to the muscles of breathing. In shock cases, the immediate, use of resuscitation substitutes the natural breathing now blocked by the shock. The current may paralyse the breathing centre as to require even 8 hours in resuscitation without a stop for again causing the natural respiration to take place.

Victims of electric shocks are unconscious but in most of the cases their hearts are working and blood circulation is taking place, only the breathing centre has stopped and ceased functioning. Their treatment demands prompt artificial respiration with the greatest possible promptness.

In order that the supplier of electricity and the consumer adopts such safety precautions which as far as possible, would keep his equipment, consumer's equipment and the general public and animal safe under all conditions, the central Government has made certain statutory acts and the Rules which at present are called Indian Electricity Rules, 1956. We shall discuss few of the important requirements of keeping the installation safe.

(a) Proper insulation:- For avoiding leakage of power through the live conductor, and thus shock to human being, it should be insulated properly. The insulation resistance should be above perscribed minimum level.

(b) Proper Earthing:- If the first line of defence i.e. insulation fails, we have to depend upon the second line of defence. In the circuit, second line of defence is provided by earth wire and fuse. In case of person touching a live conductor or appliance having leakage, supply will be disconnected automatically if earth wire and fuse of proper specification are used. Indian Electricity rules specifies the provision required to be followed for earth wire and fuses for second line of defence.

(c) Proper polarity of the single pole switches:- All single pole switches should be placed in the live wire only and not in the neutral wire. Also fuse should be inserted in live wire and not in neutral wire.

(d) Use of proper size of fuse and wires and proper joints in electrical installations should be ensured.

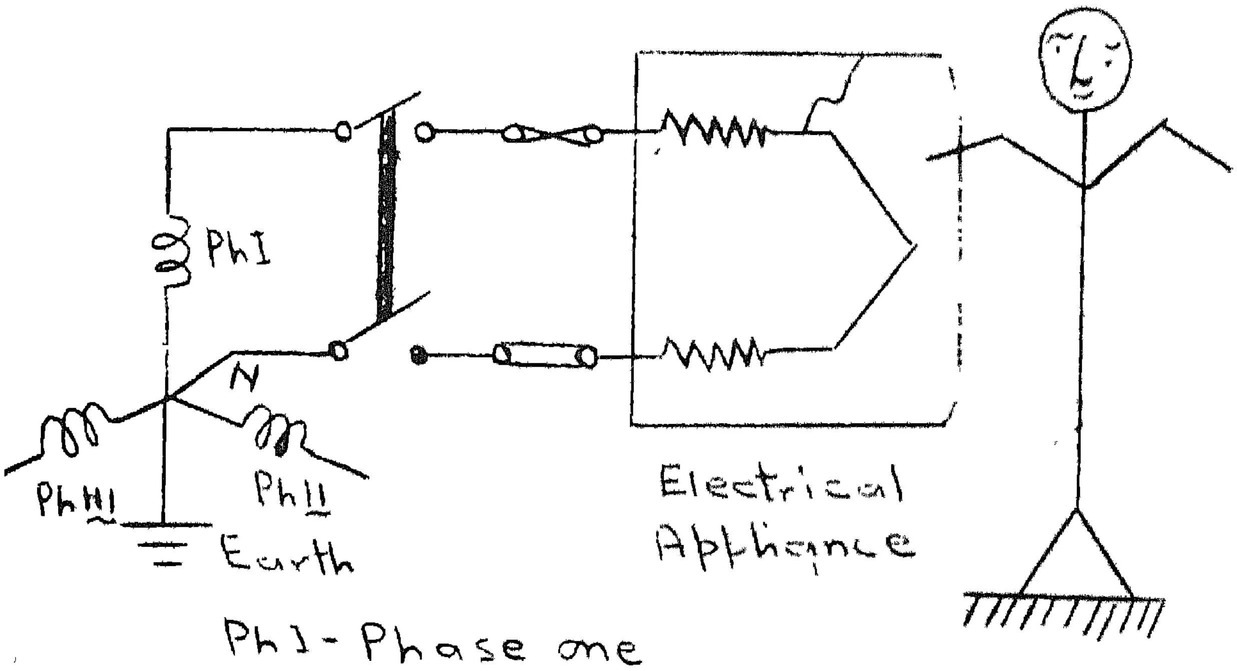
QUESTIONS FOR EVALUATION:

1. What are the causes of getting electric shock in field by human beings ?

2. How would you remove a person in contact with the live wire or supply ?

3. What are the important precautions to be observed in the electrical installations ?

Figure-1



Ph I - Phase one
Ph II - Phase two
Ph III - Phase three
N - Neutral

EXPERIMENT/PRACTICAL NO: 5

TITLE OF EXPERIMENT/PRACTICAL:

Practice of giving shock treatment-Artificial Respiration.

SPECIFIC OBJECTIVES:

To do shock treatment in the field.

Theory & Practice:

When a person is found suffering from electric shock the first thing is to cut off the supply or to disconnect the person from the supply. The hasty actions such as another person running and pulling a person who is in contact with a live conductor should be avoided as second person may also receive a shock. However, with suitable precautions and with insulations the person should be disconnected from the live conductor as early as possible.

After disconnecting the person from the supply first thing that is tobe observed is that whether he is unconscious and even under that condition he is breathing properly or not. If he is not breathing properly, then immediately artificial respiration should be started. Necessary first aid should be given for burns and injuries, if any.

Various methods of providing artificial respiration are discussed below. Before giving treatment, mouth of the person should be examined with a finger and if false teeth, betal leaf, tobacoo and chewing gum etc. are present they should be immediately removed.

Arm Lift Back Pressure Method. (Fig.1(a) and Fig.1(b)

The person to give the resuscitation drill should seat himself over the patient with his knees spread around the hips of the victim and his two hands on the small of his back. He should lean forward exerting pressure with his hands on the small of the back of the victim. This way the chest of the victim would be pressed and he would artifically exhale. Then the operator should release pressure and lean forward. The chest of the victim would expand and he would artifically inhale.

The operator should synchronise his forward and backward motion with his own exhales and inhales respectively. This cycle of motions should be about fifteen times a minute. Normal breathing of human being is 15 times a minute.

Normally one person cannot give the resuscitation drill continuously for an indefinite period. So at convenient intervals the persons must change hands at the drill and continue process without a break. The convenient interval is from 45 minute to a hour. While changing turns the rhythm of artificial respiration should not be broken.

This method is considered the best method, but if the patient is not possible to be laid prostrate because of burns, the following method is adopted.

Silverster's Method (Arm Lift chest-Pressure Method)

This method is illustrated in the figure-2. The patient is laid on his back as shown in the diagram. The person to give artificial respiration drill should seat him on the side of the head of the victim. He should hold the arms of the victim and then to bring towards his head as far as possible, flaring them outward in this motion while pressing of the armson the chest, the patient would artifically exhale; while in the backward motion of the arms the patient would artifically inhale.

The operator should synchronise his inhales and exhales to the pressing of the arms of the victim to his chest and flaring them backward. The rhythm again should be 15 times a minute. The operators should change terms convenient and while doing so the rhythm of the artificial respiration should not be broken.

The main defect of this method is that the tongue, which is boneless mass of muscle, having lost its tone due to lack of respiration, tends to fall back and block the wind pipe in about 50 percent of the cases, causing a choke, so, a second operator has to pull out the tongue and hold it. But, sometimes no second man may be available. If, however, a large thick pad is placed behind the shoulders, so that the head lies dangling downwards, the tongue does not seem to obstruct.

Mouth to Mouth Method Fig.3

In this method, the victim is laid on his back, place his head slighly down hill, if possible. A folded coat or similar object under victims shoulders will help maintain proper position. Tilt head back, so that the chin points straight upward. Grasp victims jaw as shown in position 1 and raise it upward until lower teeth are higher than upper teeth, or place fingers on both sides of jaw near ear lobes and pull upward. Main jaw position throughout resuscitation period to prevent tongue from blocking air passage.

Take a deep breath and place your mouth over victims mouth (see position 2) making air tight contact. Pinch the victims nose, shut with thumb and fore finger or close nostrils by pressing your check against them. If you hesitate at direct contact, place a porous cloth between you and victim. If an infant, place your mouth over its mouths and nose.

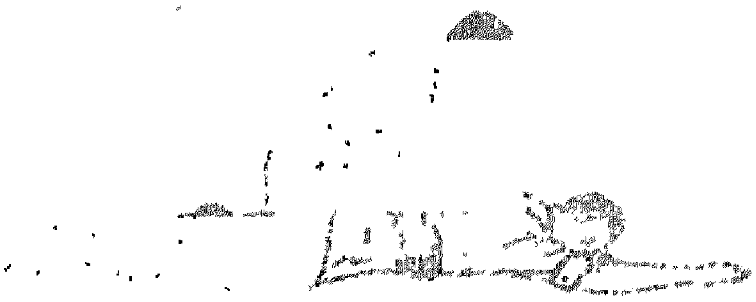
Blow into victims mouth (gently, if an infant) until his chest rises. Remove your mouth to let him exhale, turning your head to hear outrust of air. The first 8 to 10 breaths should be as rapid as victim will respond, there after rate should be slowed to about 12 times a minute (20 times if an infant).

Things to remember:

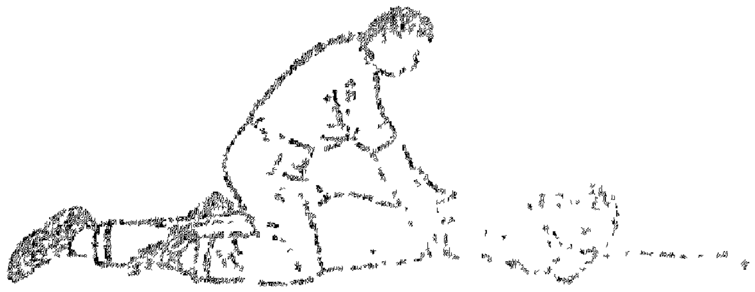
(a) If air cannot be blown in, check position of victim head and jaw and recheck mouth for obstruction then try again more forcefully. If chest still does not rise, turn victims face down and strike his back sharply to dislodge obstruction.

(b) Sometimes air entering victim's stomach evidenced by swelling of stomach during exhalation period. Instruction for the teacher:

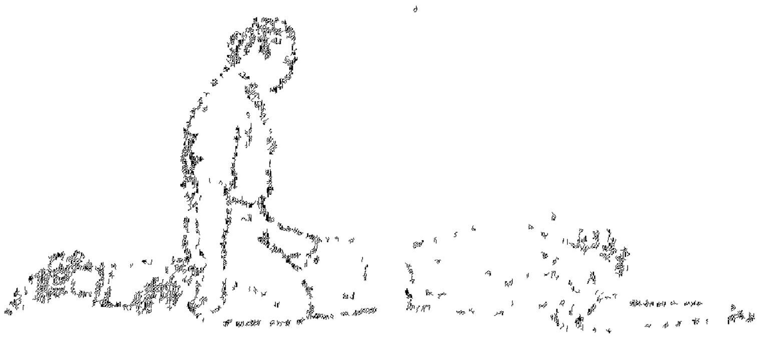
Instructor should make batches/ group of students and ask them to practice of giving artificial respiration.



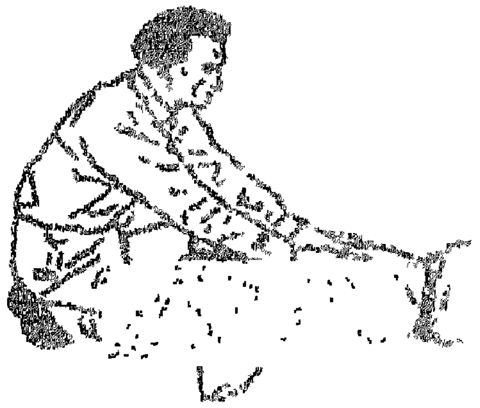
POSITION - 1



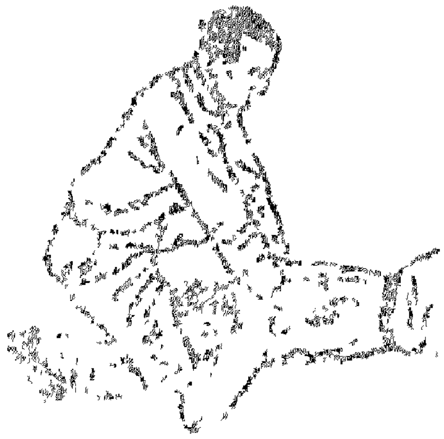
POSITION - 2



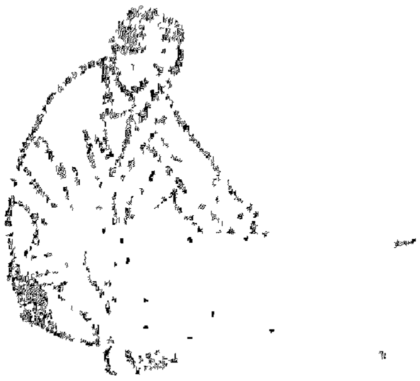
POSITION - 3



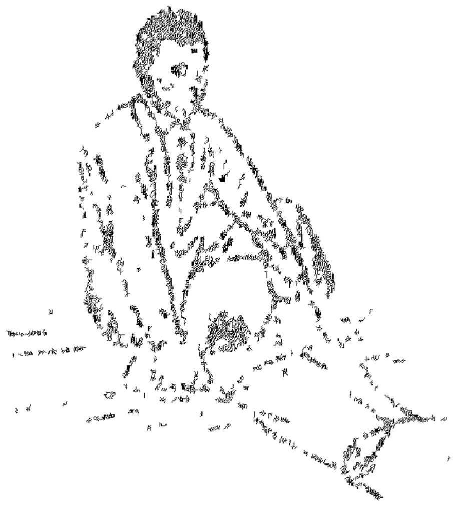
POSITION - 1



POSITION - 2



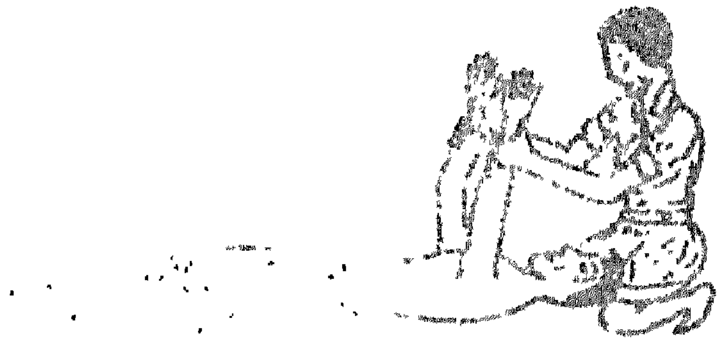
POSITION 3



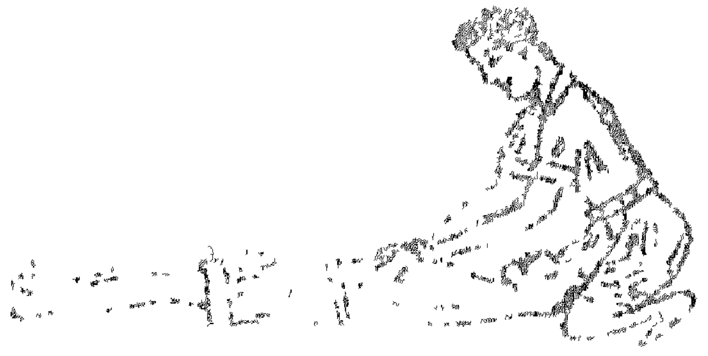
POSITION 4

FIG. [illegible]

NIELSEN'S ARM LIFT BACK-PRESSURE METHOD



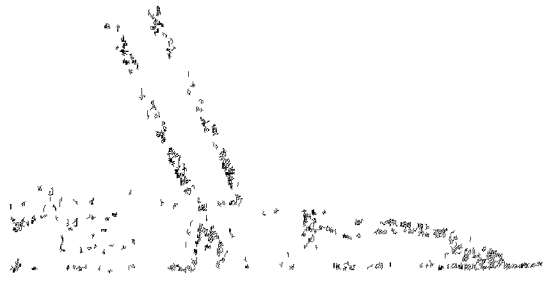
POSITION - 1



POSITION - 2

SILVESTER METHOD

(ARM LIFT - CHEST PRESSURE METHOD)



ORIGINAL

POSITION

FIG. 3

EXPERIMENT/PRACTICAL NO. 6

TITLE OF EXPERIMENT/PRACTICAL:

FIRST AID PRACTICES

SPECIFIC OBJECTIVES.

1. To tell what one should do to reduce the suffering of the patient after an accident until the doctor arrives.
2. Proper first aid may give life to a dying person.
3. To impart necessary primary medical know-how.

INTRODUCTORY INFORMATION AND RELATED THEORY :

First aid tells what to do until the doctor comes. It may mean the difference between life and death, between rapid recovery and long hospitalization. Proper first aid reduces suffering and makes the physician's job easier when he assumes the care of the patient. The responsibility of the first aider stops when the physician arrives.

EQUIPMENT AND MATERIALS :

1. First Aid Box
2. Help of a Medical practitioner

PROCEDURE :

The following general directions of first aid will enable the learner to approach his problem more intelligently:

1. Keep the injured person lying down in a comfortable position, his head level with his body, until you know whether the injury is serious.
2. Look for hemorrhage, stoppage of breathing, poisioning, wounds, burns, fractures, and dislocations. Be sure you find all his injuries.
3. Keep the injured person warm.
4. Send someone to call a physician or an ambulance.
5. Keep calm and do not be hurried into moving the injured person unless it is absolutely necessary.
6. Never give water or other liquid to an unconscious person.
7. Keep onlookers away from the injured.
8. Make the patient comfortable and keep him cheerful, if possible.
9. Don't let the patient see his own injury.

TABULAR RECORD OF OBSERVATIONS :

Instructor/teacher should arrange on the job training for these first aid practices under the supervision of some medical person or Red cross authorities. Possibly audiovisual demonstration through documentary films be given to learners.

PRECAUTIONS :

1. Severe haemorrhage must receive immediate attention, no matter what other injuries are present.
2. Burns be attended to immediately.
3. Avoid overzealous application of external heat, but maintain normal body temperature.
4. The first aider must on no account take upon himself the duties and responsibilities of a doctor.

QUESTIONS FOR EVALUATION :

1. Is it proper to allow a patient to sit up before determining the nature of his injury? why?
2. What information should be passed on to a doctor insummoning him to an accident case ?
3. Why should water or other liquid never be given to an unconscious person?

EXPERIMENT/PRACTICAL NO. 7

TITLE OF EXPERIMENT/PRACTICAL:

Use of Fir Fighting Equipments.

SPECIFIC OBJECTIVES:

1. To give introduction to different types of fire extinguishers
2. To have training in Fire Fighting Techniques.
3. To avoid damage to electrical equipment.

INTRODUCTORY INFORMATION AND RELATED THEORY:

There are very many instances in which the reason for fire accidents are an electric fault. It may be due to overheating of a cable, sparking between two line conductors or between a line conductor and earth In all such instances, it is very essential to extinguish the fire immediately. There are different types of fire extinguishers. A few of them are illustrated below:

1. Carbon Di-oxide Extinguisher

One of the important property of this is that it can be used on line circuit. In addition to extinguishing the fire it cools the apparatus without damaging the insulation or metal parts. No residue is left on the equipment or the place where it is used. However, when applied in confined spaces the carbon di-oxide should be purged out with air before workmen are allowed to enter.

2. Dry Chemical Extinguisher

It can also be used on line circuit. While it can extinguish the fire it cannot cool the equipment so effectively as does the carbon diexide extinguisher. It leaves residue on the equipment.

3. Carbon Tetrachloride Extinguisher

It will put out the fire and cool the apparatus but excessive use of this agent is detrimental to the insulation and metal parts. It is also very noxious and should be used only in well ventilated situations.

EQUIPMENT AND MATERIALS

1. Fire Fighting equipment e.g. Extinguishers
2. Buckets filled with sand etc.
3. Fire officer to train the staff
4. Suitable protective equipment, gas masks, wet cloth etc.

PROCEDURE

1. The first essential is to render the circuit dead or de-energise the electric supply before attempting to extinguish the fires.
2. Where it is not possible to switch off the current, the fire must be attached in a way which will not involve danger to the operator e.g. carbon dioxide fire extinguisher.
3. Immediately turn the alarm and intimate the control room giving exact information as to the location, type and event of fire.

TABULAR RECORD OF OBSERVATION

Instructor or teacher should ensure that training in fire fighting may include class room lectures, group discussions, circulation of accident statistics, fire drills and demonstration of fire fighting appliances reporting fibres, operation of fire alarm, response to alarm etc. Help of fire fighting staff be taken for arranging such training.

PRECAUTIONS

1. Do not throw water on live electrical equipment in case of fire. It is dangerous to you.
2. Donot use fire extinguishers on electrical equipment, unless it is clearly marked as suitable for the purpose. Use sand or blanket instead.
3. Do not forget to disconnect the supply immediately in case of fire on or near electrical apparatus.

QUESTIONS FOR EVALUATION

1. Why water should not be used for extinguishing electrical fire ?
2. Name three types of extinguishers ?
3. Why fire fighting training is essential ?
4. Why line circuit be rendered dead ?

EXPERIMENT/PRACTICAL NO: 8

TITLE OF EXPERIMENT/PRACTICAL

Identification of parts/components of domestic supply line and industrial supply line.

SPECIFIC OBJECTIVE:

1. Recognise various parts of domestic supply line and industrial supply line from the given drawing
2. Draw pictorial diagram of the domestic, indutsrial supply line and Tubewell.

Theory & Practice:

Electrical power from the generating station is carried to the substation near cites through transmission line. Here the voltage is stepped down to 66 or 33 KV and carried through three wire transmission lines to various substation in the cities, where the voltage is further stepped down to 11, 6.6 or 3.3. KV. These voltages are further stepped down to 415 V, three phase, four wire supply. Such small consumers may take electric power from 415 V, three phase, four wire supply in which case they can use single phase as well as three phase equipment; or they may take single phase supply, i.e. one of the live lines and neutral line giving them supply at 240V. This is called secondary or low voltage distribution system. Electric power to large consumers is supplied at 11,6.6 or 3.3 V through three wire systems. This is called primary or high voltage distribution system.

The suppliers distribution system brings power to the consumer through overhead lines or by means of underground cables to a place just outside the consumer's premises.

The line bringing electric power from supplies low voltage distributor upto the energy meter installed at the consumer's premises is called the service connection.

Types of Service Connection.

Service connection may be by means of underground cables or by means of overhead conductor or cables.

Figure 1(a) to 1(c) shows:-

(a) An underground service connection taken from overhead distribution system.
(b) PVC Weather proof cable service line.
(c) Service connections through GI pipes.

PROCEDURE

The teacher should take students on actual site and show various types of service connections and electrical accessories used. Students will draw the pictorial sketch of the lines and accessories on the note book and note following information

(1) Type & number of insulator
(2) Type and number of wire.
(3) Type and number of pole and stay wire.
(4) Which out of neutral and phase wire is at higher level from the ground.

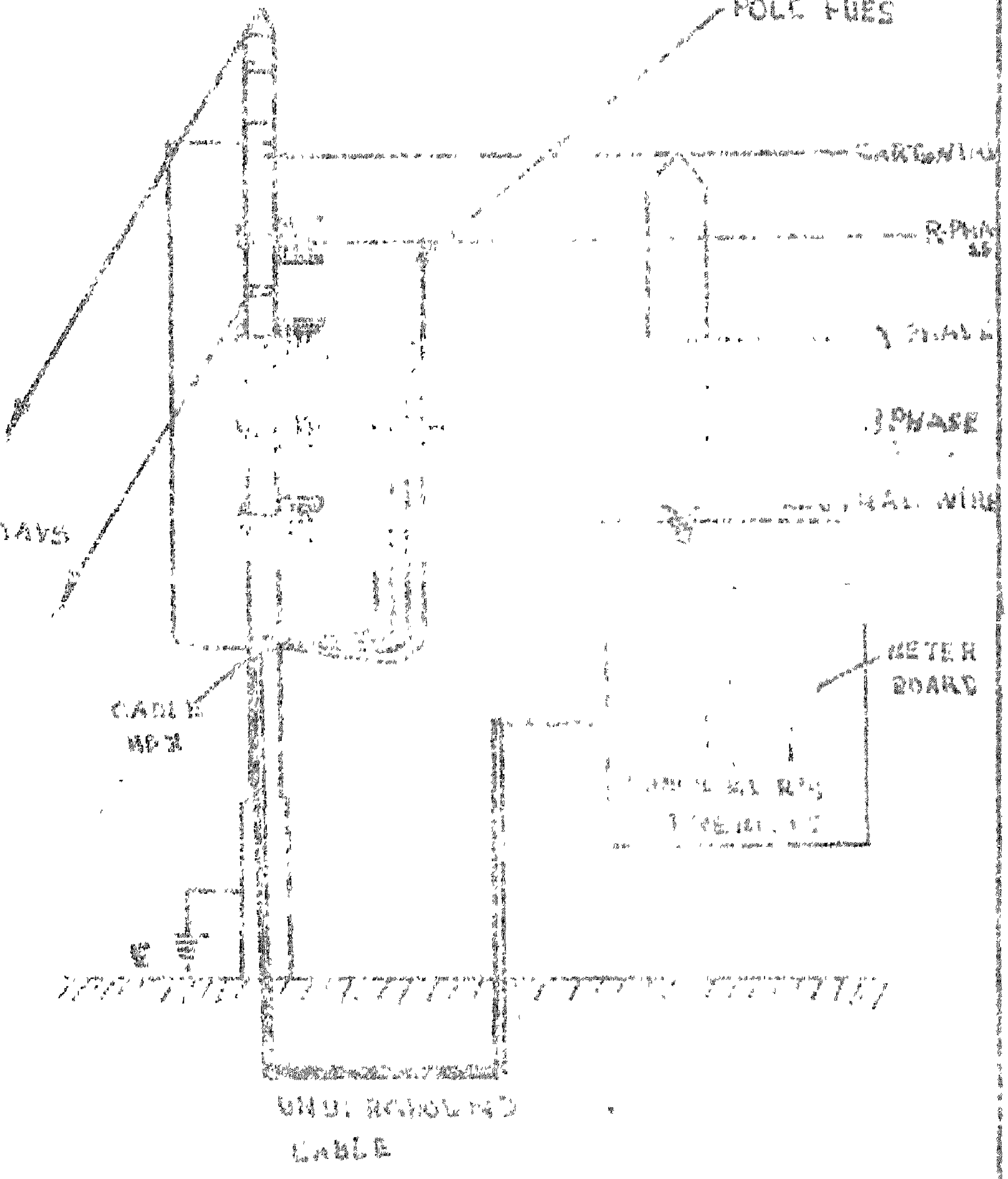


Fig1(c) [illegible] Service Connection Taken from [illegible]

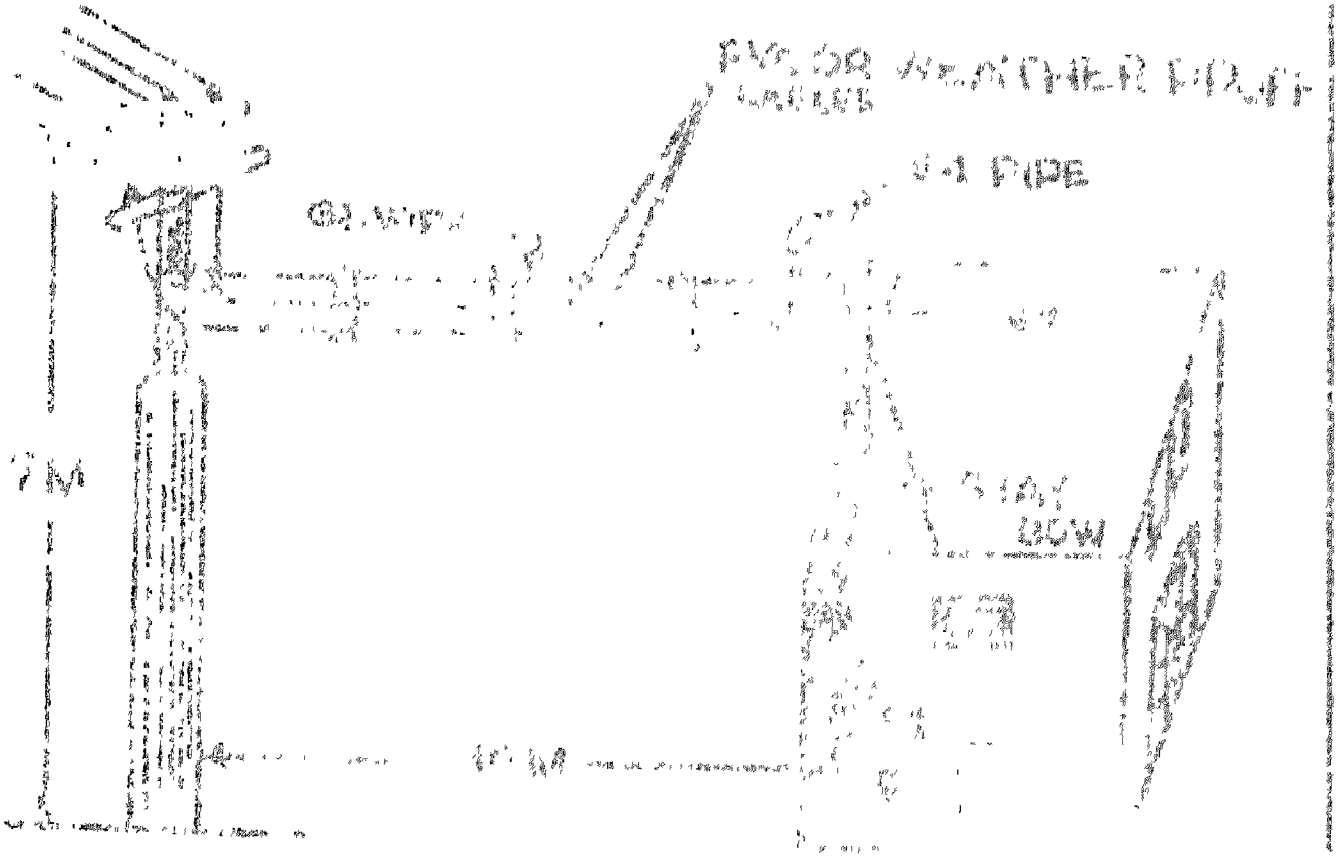


Fig 1(b)

PVC WEATHER PROOF CABLE

SERVICE LINES

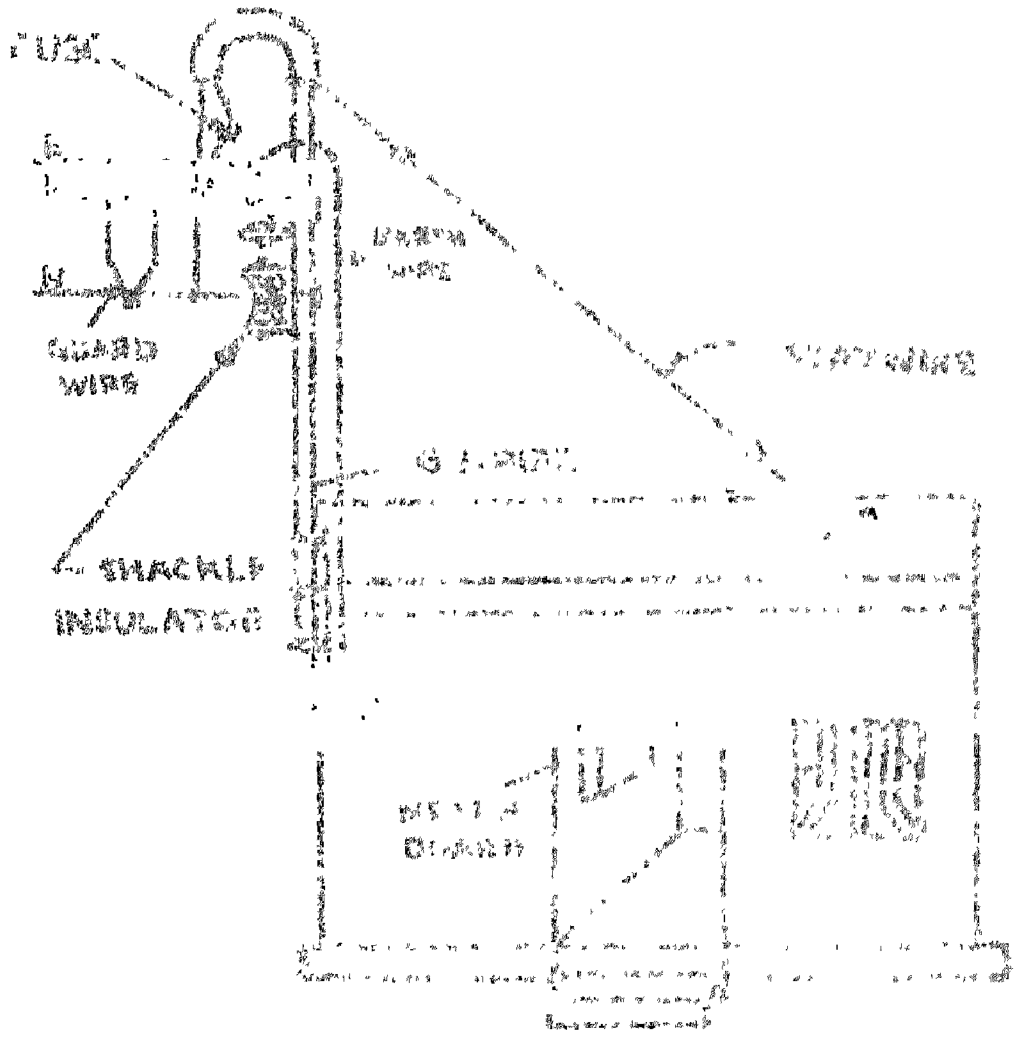


FIG. 3(C) SERVICE CONNECTIONS THROUGH G.I. PIPES

EXPERIMENT/PRACTICAL NO: 9

TITLE OF EXPERIMENT/PRACTICAL

Practice of making Test report of an electrical installation.

SPECIFIC OBJECTIVE :

1. Understand the various terms used in finding the connected load of an installation.
2. Prepare test report of a wiring installation.

Theory & Practice

For preparing test report of an electrical installation, it is essential to know about the rating or power consumed by various devices. The following table gives power consumed by various appliances.

Power Consumption of Appliances

Appliance	Consumption in Watts	
Inacadenscent lamp	10 upwards	
Fluorescent lamps(1.5 ft to 6ft)	15 to 125	
Clock	2 to 3	
Radio	40to 150	
Television	200 to 400	
Heater	1000 to 3000	
Table fan	30 to 60	
Ceiling fan	60 to 130	
Airconditioner room type	800 to 1500	
Geyser	3000 to 5000	
Refrigerator, house hold	150 to 300	
Iron (steam or dry)	660 to 1100	
Washing Machine	350 to 550	
Motors: 1/4 hP	300 to 400	Approx. figures.
1/2 hP	450 to 600	
over 1/2 hp per hp	950 to 1100	

The details of various Energy consuming devices is fitted in Wiring contractors Test Report and Departments Installation Test ORDER PERFORMA. attached.

In building lighting and power load has to be supplied. The details of energy consuming apparatus / motors connected are as follows :

Devices	Rating	Number
1. Lamps	60W	10
2. Television	200W	1
3. Heater	1500W	2
4. Ceiling fan	60W	4
5. Airconditioner	800W	2
6. Geyser	300W	1
7. Washing Machine	350W	1
8. Iron(steam 700W)	700W	1
9. Motors 1/2hp	500W	5

Fill up the performa and determine total connected loa

(See Schedule attached)

QUESTIONS FOR EVALUATION

1. Why do we use test report in electricity Board.
2. What are the details given in the test report.
3. What is the range of energy consumed by a fluoresent lamp, Heater & Airconditioner.

SCHEDULE OF ENERGY CONSUME APPARATUS TO BE CONNECTED

No.of circuit lefteor right on distribution board.	Size of conductor.	LAMPS EACH RECKONED AS 60 WATTS									Total connected load KW	INSULATION TEST IN MEAGACHMS					
		No.	Total Watts	Description No.	Wattage each.	Total watts.	BHP No.	each KW	total KW			Wiring conductor test Electricity Dept.Test.					
												Between conductors	Between conductors & earth.	Between conductors.	Between conductors and earth		
												Between conducting any lamp or any apparatus.	Before connecting any lamp or apparatus.	After connecting lamps & apparatus.	Before connecting any lamp or apparatus.	Before connecting any lamp or apparatus.	After connecting any lamp or apparatus.
		10	600	Heater-1	1500	1500	5	500W	2500W	1009KW							
				Television -1	200	200											
				Ceiling fan-4	60	240											
				Airconditioner -2	800	1600											
				Geyser -1	3000	3000											
				Washing Machine-1	350	350											
No.1.				Iron (steam)-1	700	700											

To be filled by wiring contractor after performing actual test.

EXPERIMENT/PRACTICAL NO: 10

TITLE OF EXPERIMENT/PRACTICAL:

CONNECTION OF LAMPS AND DOMESTIC APPLIANCES IN SERIES AND IN PARALLEL.

SPECIFIC OBJECTIVES:

1. To connect two lamps in series
2. To connect two lamps in parallel
3. To connect one lamp and one domestic appliances (heater, toaster & Press etc.) in series.
4. To connect one lamp and one domestic appliance (heater, loaster and Press etc.) in parallel.

INTRODUCTORY INFORMATION AND RELATED THEORY

1. In the series circuit all the elements (lamps, domestic appliance etc) of the circuit are connected onto each other as illustrated.in Fig 1 and Fig.3. The same current from the supply flows through all the elements If for any reason one of the elements burnsout, all the elements will go out because the circuit is no longer closed.

2. In parallel circuit each element is individually connected across the supply as shown in the Fig.2 and Fig.4 . If any element burns out in such arrangement, the remaining elements will continue to work, as the path for current through each element is still closed.

EQUIPMENT AND MATERIALS

1. Flexible wires
2. Two-lamps with holders.
3. Insulated plier, Screw Drivers etc.
4. Domestic appliances (Heater, toaster or Press) rated at 2 30V.

CIRCUIT DIAGRAM

Lamp I

Lamp 2

Phase

Supply

Neutral

Lamp

Series Circuit.

Fig.1

Phase

Supply

Lamp 1

Lamp 2

Neutral

Lamp

Parallel Circuit

Fig.2

Lamp

Heater

Phase

Supply

Neutral

Lamp and domestic appliance
connected in series.

Fig.3

Phase

Lamp

Electric
Heater.

Supply

Neutral

Lamp and domestic appliance
[illegible]

Fig.4

PROCEDURE :

1. Make the connections as per circuit diagrams.

2. Connect the circuits to the supply system.

TABULAR RECORD OF OBSERVATIONS:

'For supply 'ON' , observe and tick off the correct.

S.No.	Circuit condition.	Observations.
1.	Lamps L_1 and L_2 in series.	L_1 and L_2 both glowing/not glowing.
2.	Lamp L_1 removed.	L_2 glowing/not glowing.
3.	Lamp L_2 removed. and L_1 in position.	L_1 glowing/not glowing

PRECAUTIONS:

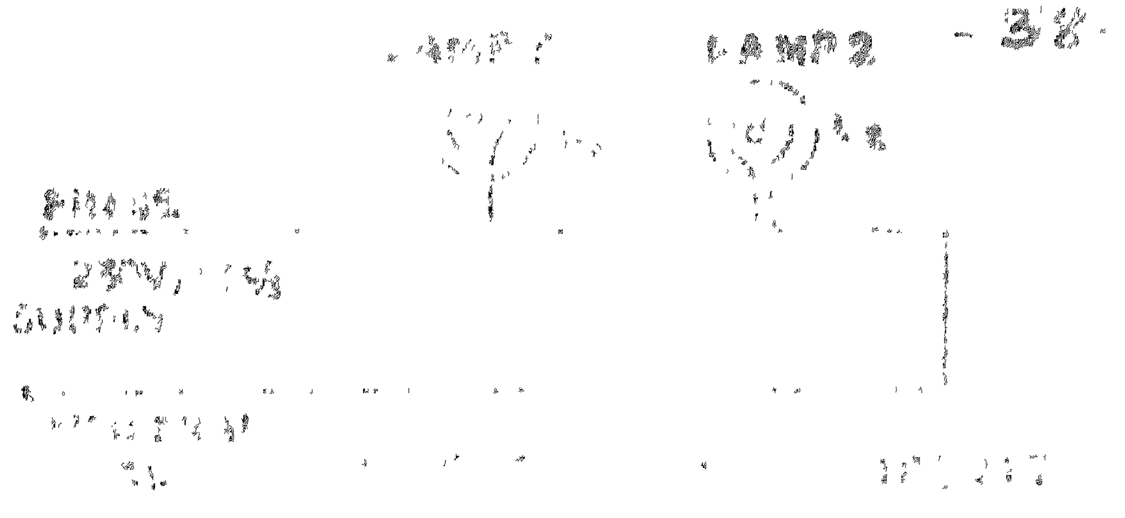
1. Check the specifications of the appliances with respect to the supply voltage.
2. All connections should be tight.
3. Circuit to be connected to the supply last.
4. Do not touch the terminals when the supply is on.

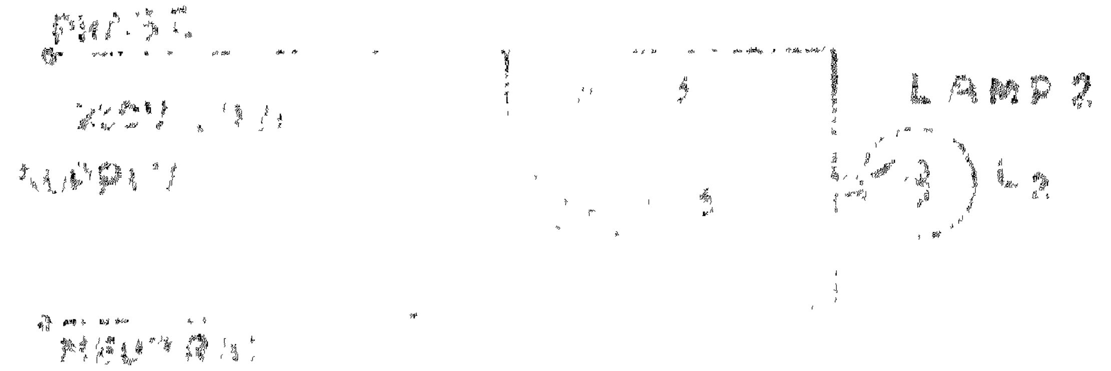
QUESTIONS FOR EVALUATION:

1. In circuit No.1, when lamp L_1 is removed. L_2 does not glow; why ?
2. In circuit No.2, when lamp L_1 is removed L_2 continues to glow; why ?
3. What will happen if an appliance of voltage rating 230 volts is connected to the supply voltage equql to i) double the voltage rating of the appliance ii) Half the voltage rating of the appliance.

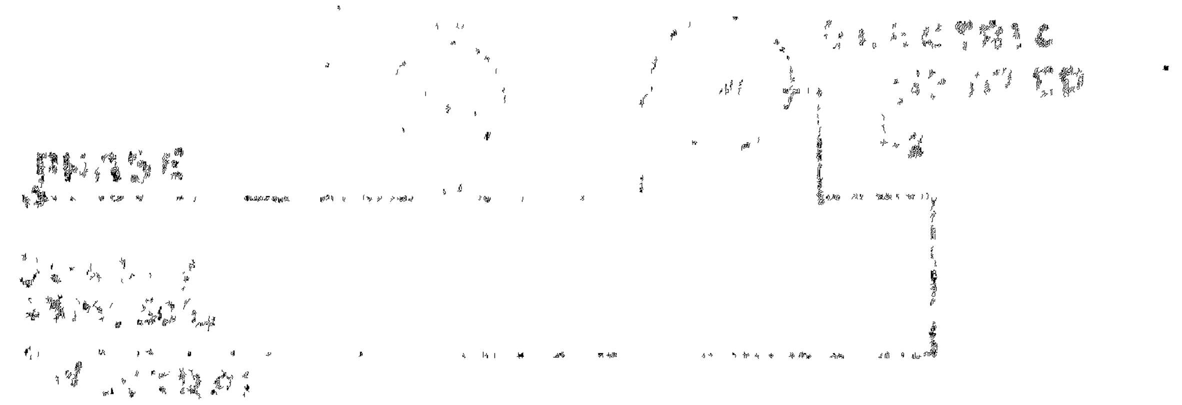
Reference

The Lineman's and Cableman's Handbook- KURTZ, McGraw-Hill.





[illegible] CIRCUIT



[illegible] AND DOMESTIC [illegible] IN SERIES

EXPERIMENT/PRACTICAL NO: 11

TITLE OF EXPERIMENT/PRACTICAL

Use of phase tester and test lamp.

SPECIFIC OBJECTIVES:

1. To test the phase and neutral terminals of a supply.
2. To test the presence of supply with the help of a testlamp.

INTRODUCTORY INFORMATION AND RELATED THEORY

1. When the phase tester is touched to any terminal of the supply, the path of the current is closed through the neon bulb and the high resistance inside the tester and the person holding the tester. If the terminal is live (phase) then the bulb will glow. If the terminal is neutral then the bulb will not glow because the potential difference is almost zero between the neutral and the earth.

2. One terminal of the test lamp is permanently connected to earth and the other is touched to the supply terminal under test . Glowing of lamp indicates the terminal is live (phase). Otherwise, the terminal is neutral.

EQUIPMENT AND MATERIALS

1. Phase tester 500 volts.
2. One pendent lamp holder.
3. One lamps 100 watts, 250 volts.
4. Connecting wires P.V.C.
5. One plier, screw drivers, etc.

CIRCUIT DIAGRAM:

As shown in figure 1 and 2

PROCEDURE

(a) Testing with phase tester

1. Hold the phase tester in your hand touching the metal cap.
2. Touch the tip of the tester with the terminal of the supply
3. Repeat the above for other terminals of supply also and observe.

(b) Testing with test lamp

1. Connect one wire of the test lamp with earth firmly.
2. Touch the other wire of the test lamp with any terminal of the supply.
3. Repeat the above for other terminals of supply also and observe.

TABULAR RECORD OF OBSERVATIONS

For phase tester

Sr.No.	Phase tester operation.	Observations.	Remarks.
1.	Phase tester is touched to one of the terminals of the supply.	The tester neon lamp does not glow.	The terminal be the neutr terminal.
2.	Phase tester is touched to the other terminal of the supply.	The tester neon lamp glows.	The terminal the live(phas terminal of supply.
3.	Phase tester is touched to both the terminals of the supply in turn.	The tester neon lamps does not glow in either case.	There is no su

For test lamp

S.No.	Test lamp operation	Observations.	Remarks.
1.	Test lamp is connected between one of the terminals of the supply and earth.	Test lamp does not glow.	The supply term may be neutral terminal.
2.	Test lamp is connected between the other terminal of the supply and the earth.	The test lamp glows.	The terminal is the live(phase) terminal of the supply.
3.	Test lamp is connected between the two terminals of the supply in turn and the earth.	The test lamp does not glow in either case.	There is no supply.

PRECAUTIONS:

1. All connections should be firm.
2. The metal cap in the tester should be touched for completing the circuit.
3. While using neon phase tester shoes having rubber soles should not be put on.

4 Neon phase tester should be gripped firmly in hand to avoid electric shock.

5. The bare conductors of the connecting wire of the test lamp should be properly twisted.

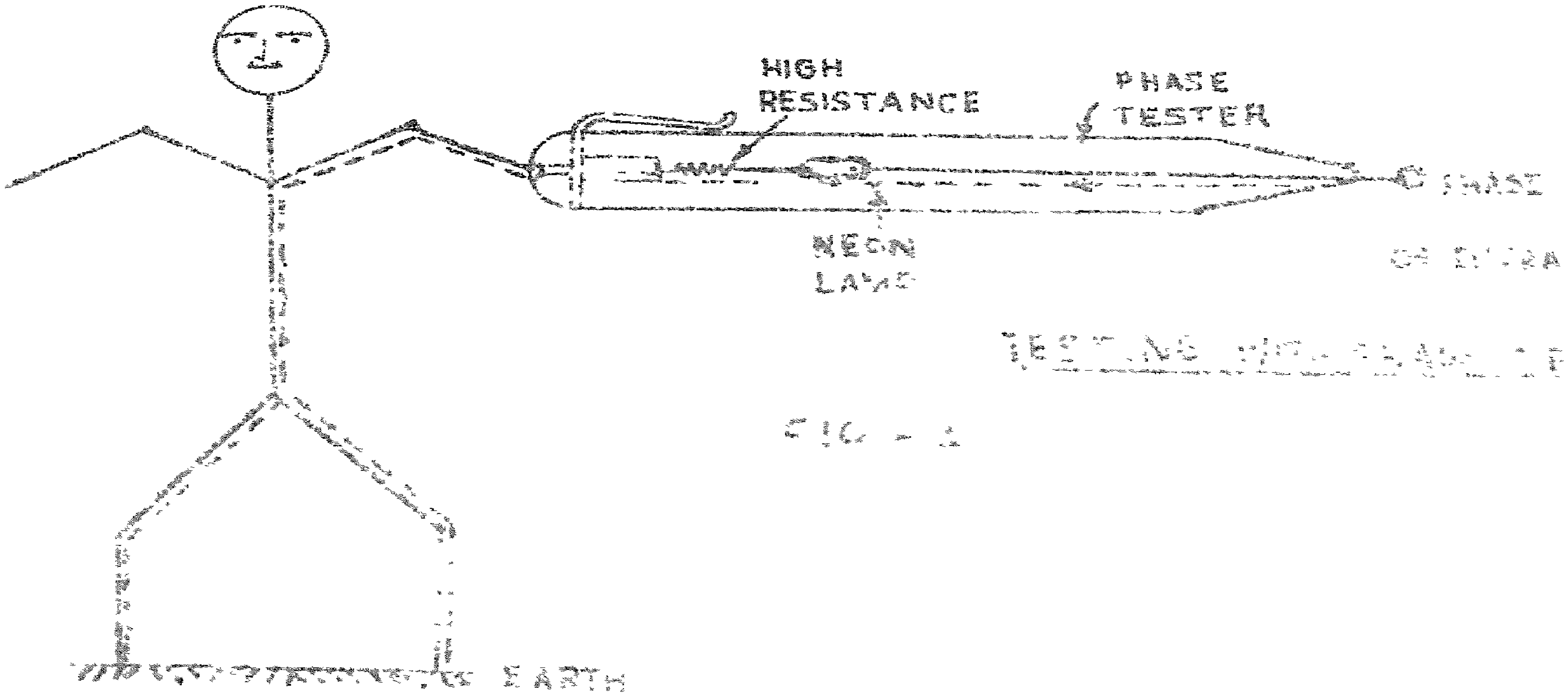
QUESTIONS FOR EVALUATION:

1. If the neon phase tester is used after putting on the rubber hand gloves whether the tester will glow ?

2 What do you conclude if the neon tester shows a very dim glow ?

3. Will the test lamp glow when connected between live (phase) and earth ?

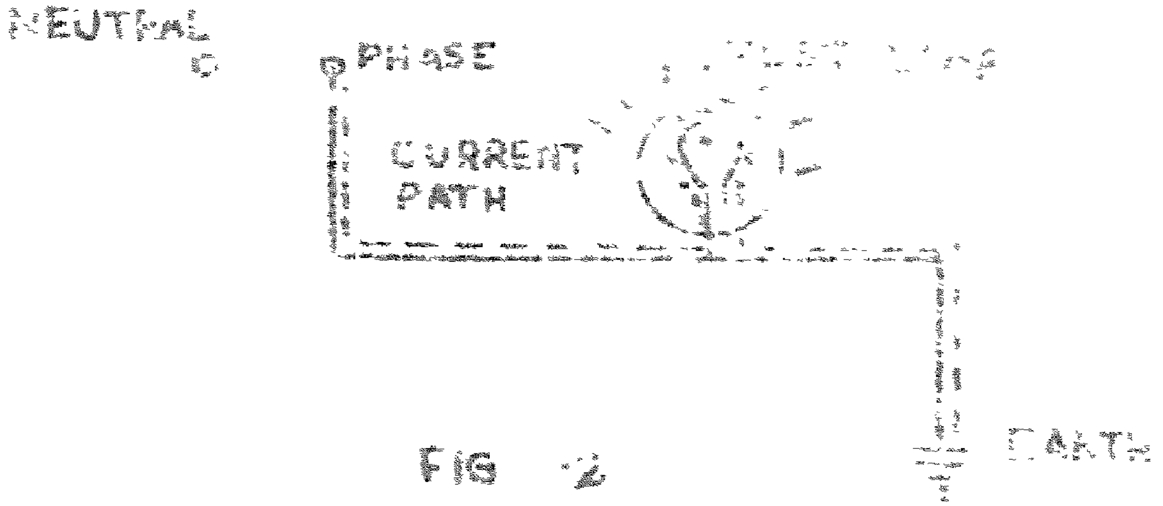
4. Test lamp glows when connected between live (phase) and earth but does not glow between live(phase) and neutral wire. This indicates that there may be a break in (a) the line,(phase) wire (b) neutral wire (c) earth wire. Which possibility, do you think, is correct ?



[illegible]

TESTING [illegible]

FIG – 1



[illegible]

[illegible]

FIG 2

EXPERIMENT/PRACTICAL NO: 12

TITLE OF EXPERIMENT/PRACTICAL:

Making a series parallel testing board.

SPECIFIC OBJECTIVES

1. To prepare a testing board for series-parallel testing of equipment.
2. To make available the supply at a working place.

INTRODUCTORY INFORMATION AND RELATED THEORY:

Series- parallel test board is prepared in order to test the equipment for probable faults. First the equipment is connected in series with a lamp in the test board and if the lamp glows dim then the equipment is in working condition. Now the equipment is put in parallel with a lamp in the test board and lamp glows bright and the equipment also gives full output.

EQUIPMENT AND MATERIAL:

1. T.W board size 20 cm x 25 cm.
2. Two batten holders 250 volt, 5 A,
3. Two lamps 100 W, 250 V/230V.
4. One fuse cut out unit 5A, 250V.
5. One neutral link.
6. 3 single way switches 5A, 250V.
7. 2 Nos, 2 pin sockets 5A, 250 Volt.
8. Connecting wires.
9. Plier, screw driver, wood saw, drill screws etc.

CIRCUIT DIAGRAM Fig. 1

PROCEDURE

1. Procure the materials as per specification.
2. Arrange the tools and equipments.
3. Mark the position of various components, on the board, to be fixed there.
4. Fix the components on the board.
5. Complete the wiring in the board as per the circuit diagram shown in Fig.1

6. Test the board by connecting phase and neutral to supply and putting the appliance under test across SOC-1.

TABULAR RECORD OF OBSERVATION:

1. When phase and neutral wires of the board are connected to the supply and switch S_2 is in ON position the lamp L glows.

2. The equipment under test is put across socket 1. The switch SI is made ON. The lamp SL will glow dim.

3. Connect the appliance across the socket SOC_2 and put ON the switch S_3. The appliance should give full output.

PRECAUTIONS

1. All connections should be firmly made.

2. The phase terminal of the supply should be connected to the board through the fuse cut out.

3. The Neutral link of the board is to be connected to the neutral of the supply.

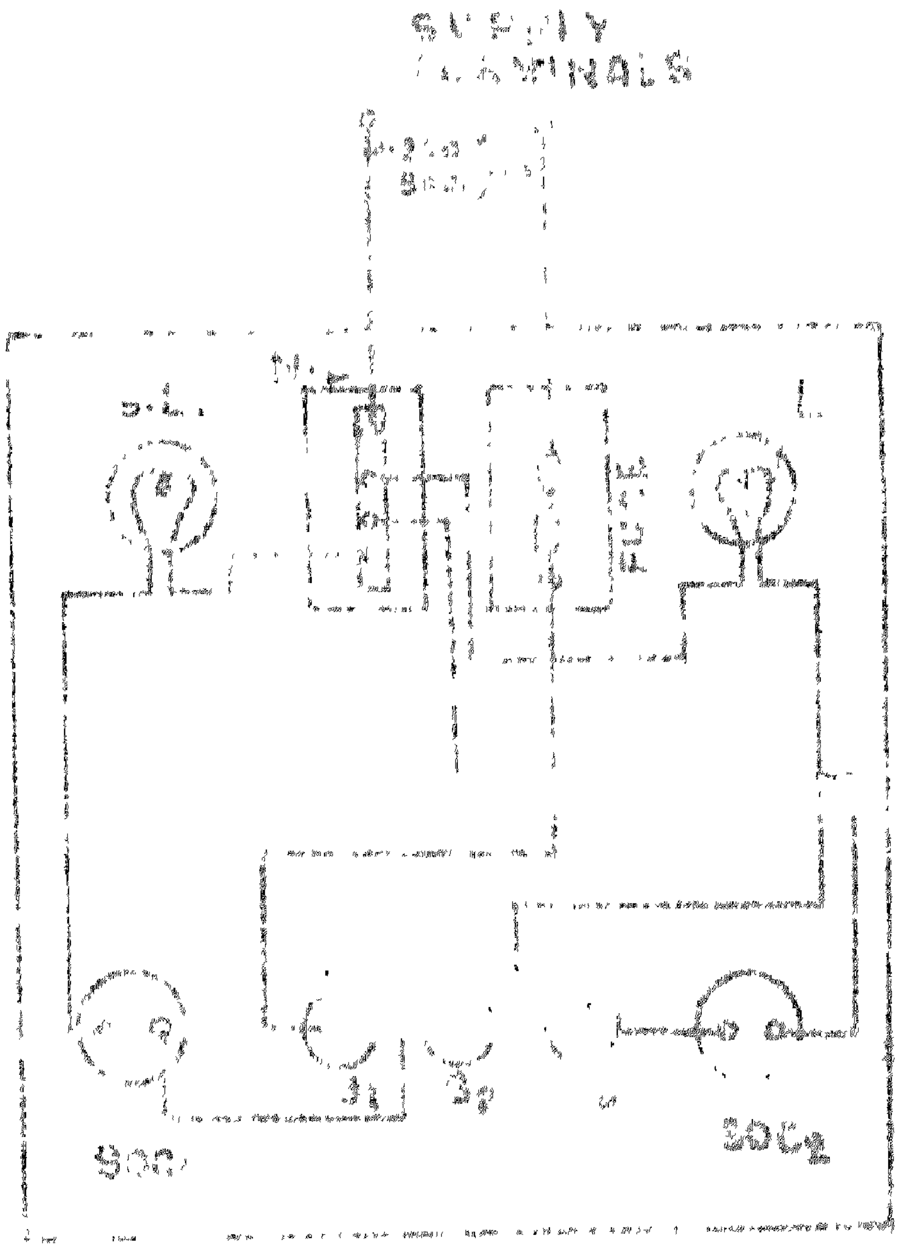
5. All accessories should be fixed properly.

QUESTIONS FOR EVALUATION:

1. Supply is given to the board, Switch S2 and made ON but the lamp L does not glow. What may be the possible reasons?

2. When the appliance is connected across Socket-1 and the switch SI is made ON, the lamp SL glows dim. Why ?

3. Under what conditions the lamp SL will glow brightly ?



N.L. – NEUTRAL LINK

S.L. – SERIES LAMP

L – LAMP

S_1, S_2, S_3 – SINGLE WAY SWITCHES

SOC_1, SOC_2 – TWO PIN SOCKET.

Fig 1

ELECTRICIAN'S TEST BOARD.

EXPERIMENT/PRACTICAL NO: 13

TITLE OF EXPERIMENT/PRACTICAL

Control of one lamp from one point.

SPECIFIC OBJECTIVES:

To make a circuit so that a lamp can be controlled with one switch only.

INTRODUCTORY INFORMATION AND RELATED THEORY:

It works on the principle of a series circuit i.e. the lamp and switch are connected in series and the combination is connected to the supply for operation. When put to 'OFF' position the switch will offer infinite resistance and the current path will not be closed. Hence the lamp will not glow. When put to 'ON' position the switch will offer zero resistance and current path will be closed. So the lamp will glow.

EQUIPMENT AND MATERIALS

(1) Single way switch 5A, 250 V. - One No.
(2) Pendant holder 5A, 250 V. - One No.
(3) Connecting wires
(4) Lamp 60W, 250 V. - One No.
(5) Plier, screw driver etc.

CIRCUIT DIAGRAM:

(see fig. 131)

PROCEDURE:

1. Arrange the tools and raw materials.
2. Make the connections as shown in the Circuit diagram.
3. Put the lamp in the holder.
4. Connect the phase and Neutral to supply.
5. Put the switch 'S' at 'ON' position.

TABULAR RECORD OF OBSERVATION

When switch is put at 'ON' position the lamp 'L' glows and when switch 'S' is put at 'off' position, the lamp does not glow.

PRECAUTIONS:

1. All connections should be firmly made.
2. The switch should be put on the phase wire.

QUESTIONS FOR EVALUATION:

1. Why the lamp does not glow when the switch is in 'OFF' position ?
2. Why the switch should be put on the phase wire ?
3. When the switch is in the 'OFF' position why does it offer infinite resistance ?

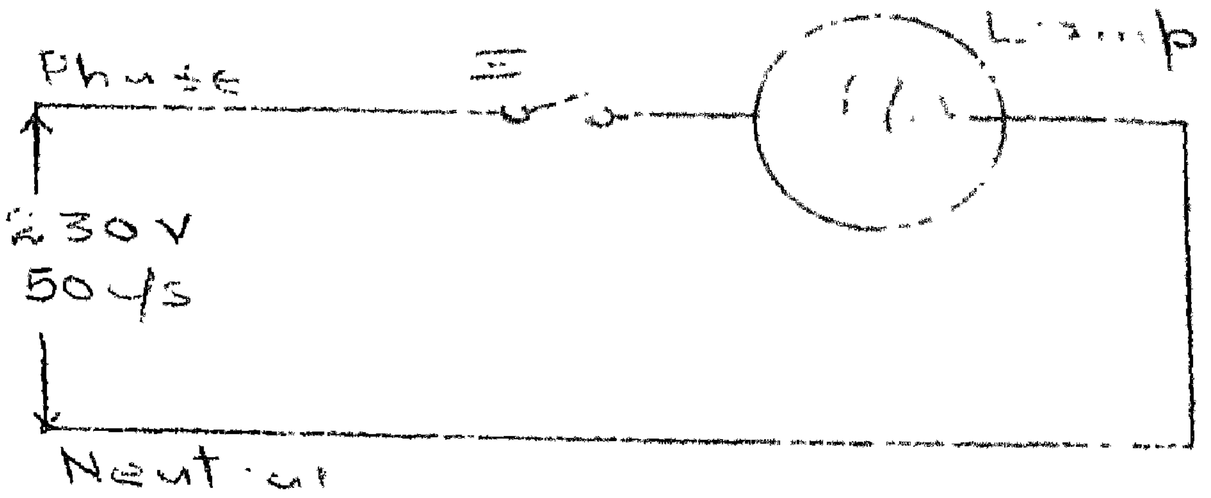


Fig. 13.1. One lamp circuit

EXPERIMENT/PRACTICAL NO: 14

TITLE OF EXPERIMENT/PRACTICAL :

Control of one lamp from two points.

SPECIFIC OBJECTIVES :

1. To understand how one lamp can be controlled by two switches located at different places.
2. To make the student aware that this circuit is actually used in staircases.
3. To make the circuit practically.

INTRODUCTORY INFORMATION AND RELATED THEORY.

The circuit consists of one lamp and two numbers of two way switches connected as shown in the circuit diagram. The common points in switches S_1 and S_2 are C_1 and C_2 respectively. Let the common point C_2 is connected to position 2' in switch S_2. Now if the common point C_1 is contacted to position 1'' in switch S_1 then the path of the electric current is not complete and hence the lamp will not glow. However, if C_1 is contacted to position 1' then the path of current is completed through S_1, S_2 and the lamp. The lamp will now glow, Similarly if C_2 is now contacted to position 2 at switch S_2 the circuit is interrupted and the lamp will not glow.

This shows that the lamp can be controlled independently either by switch S_1 or Switch S_2 This is the system followed in staircases lighting.

EQUIPMENT AND MATERIALS :

1. One lamp holder (Pendent) 5A, 250 V
2. One lamp 40 Watts, 250 V.
3. Two wayswitch, 5A, 250 Volts - two nos.
4. Connecting wires.
5. Plier, screw driver etc.

CIRCUIT DIAGRAM :

(See Fig. 1)

PROCEDURE :

1. Connect the lamp with the two switches S_1 and S_2 with the help of tools and raw materials.
2. Put the lamp in position in the holder.

3. Mark the positions 1 and 1' on S_1 and S_2 and 2 and 2' on S_2.
4. Operate switch S_1 in positions 1 and 1'
5. For each position of S_1, put switch S_2 in position 2 and 2' respectively.
6. Observe the results.

TABULAR RECORD OF OBSERVATIONS.

S.NO.	Position of contact C_1 in Switch S_1	Position of contact C_2 in Switch S_2	Remar
1.	C_1 in contact with 1	C_2 in contact with 2	Lamp glows/do not glow.
2.	C_1 in contact with 1	C_2 in contact with 2'.	Lamp glow/does not glow.
3.	C_1 in contact with 1'	C_2 in contact with 2'.	Lamp glows/does not glow.
4.	C_1 in contact with 1'	C_2 in contact with 2	Lamp glows/does not glow.

PRECAUTIONS :

1. All connections should be firmly made.
2. Switches S_1 and S_2 should be put on the phase wire.

QUESTIONS FOR EVALUATION

1. When the lamp is initially glowing, what do you expect if one of the switches is operated?
2. When the lamp is initially glowing, what do you expect if bot the switches are operated simultaneously?
3. When the lamp is not glowing initially, what do you expect if both the switches are operated simultaneously?

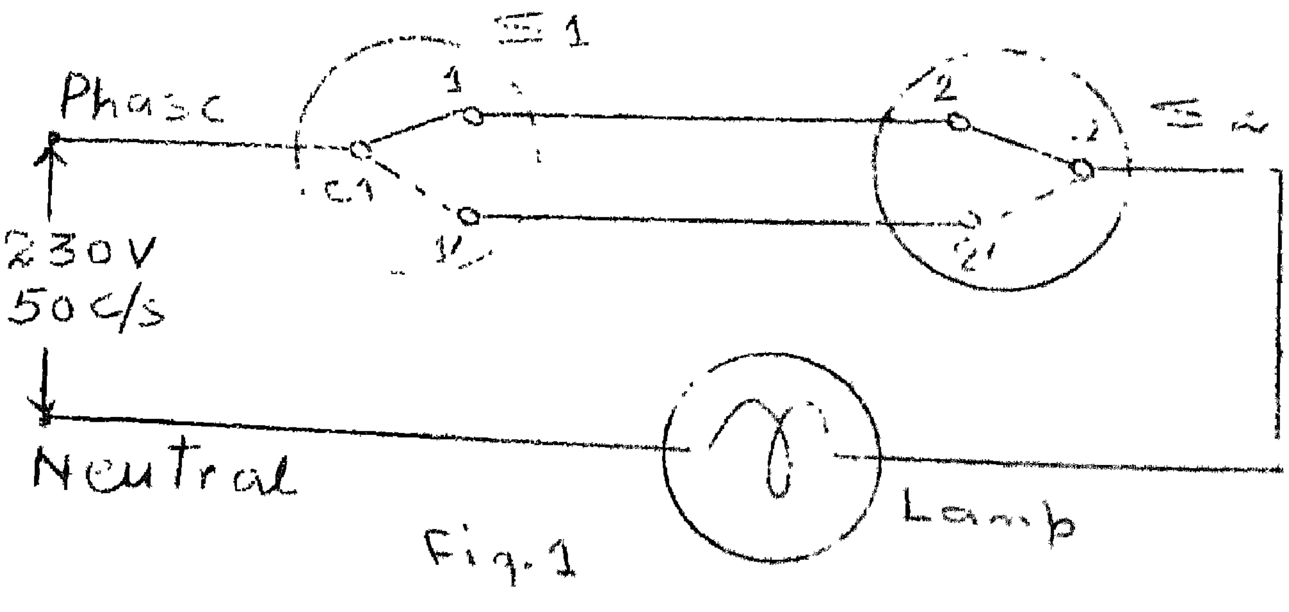


Fig. 1

EXPERIMENT/PRACTICAL NO. 15

TITLE OF EXPERIMENT/PRACTICAL :

Control of one lamp from Three points.

SPECIFIC OBJECTIVES :

1. To understand how one lamp can be controlled by three switches situated at different places.
2. To understand how [illegible] lights are controlled from different floors.
3. To make the circuit [illegible].

INTRODUCTORY THEORY AND INFORMATION.

It was learnt [illegible] lamp and the switches [illegible] connected to the [illegible]. When [illegible] closed then only lamp will glow.

EQUIPMENT AND MATERIALS

1.	Lamp holder (Pendant), 5A, 250 V	1 No.
2.	Two-way switch, 5A, 250 V	2 Nos
3.	Intermediate switch.	1 No.
4.	Lamp 40 watts, 250 V/230V	1 No.
5.	Connecting wires	
6.	Plier, screw driver etc.	

CIRCUIT DIAGRAM :

(See Fig. 1)

PROCEDURE :

1. Arrange the tools and raw materials.
2. Make the connections as per the circuit diagram.
3. Put the lamp in the holder.
4. Connect the phase and Neutral to supply.
5. Change the position of any switch (say S_1) and observe.
6. Change the position of another switch (say S_2) and observe.
7. Change the position of the third switch (i.e. S_3) and observe.

TABULAR RECORD OF OBSERVATIONS :

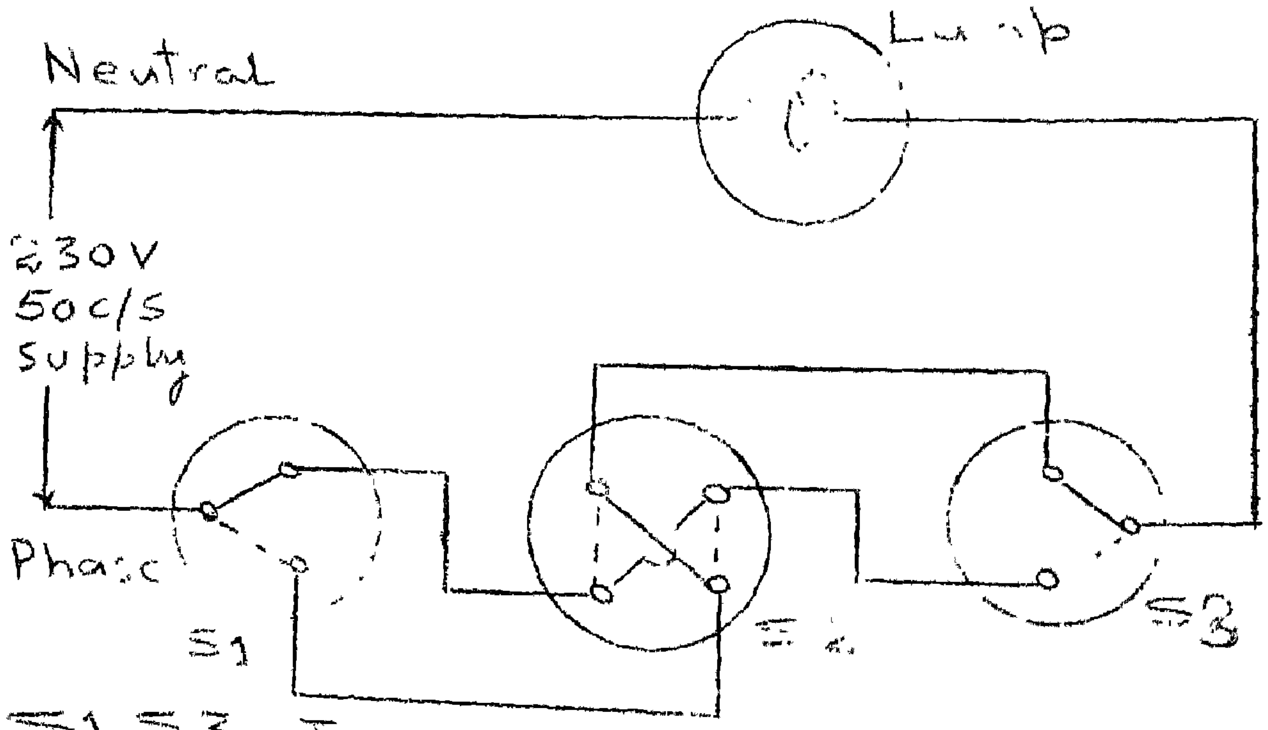
SL.	Position of Switch	Condition of Lamp
1.	As shown in the diagram.	Glowing/Not glowing.
2.	Position of S_1 changed.	Glowing/not glowing.
3.	Position of S_2 changed.	Glowing/Not glowing.
4.	Position of S_3 changed.	Glowing/Not glowing.

PRECAUTIONS :

1. All connections should be firmly made.
2. Switches should be put on the phase wire.

QUESTIONS FOR EVALUATION :

1. If the position of one switch is changed at a time what wil be the condition of the lamp?
2. If the position of two switches are simultaneously changed what will be the condition of the lamp ?
3. If the position of three switches are simultaneously chang what will be the condition of the lamp?



S1, S3 - Two-way Switch
S2 - Intermediate Switch

Fig.1

EXPERIMENT/PRACTICAL NO: 16

TITLE OF EXPERIMENT/PRACTICAL

Making a Brittania Joint.

SPECIFIC OBJECTIVES:

1. To understand the use of a Brittania joint.
2. To actually make the Brittania joint with (a) Copper conductors, (b) steel wires (c) Aluminium conductors

INTRODUCTORY INFORMATION AND RELATED THEORY:

This joint is required since the wires are manufactured in a specific length and the total length of wire used for a particular job may be more than that.

EQUIPMENT AND MATERIALS:

1. Copper conductors.
2. Aluminium conductors.
3. Steel wires
4. Knife
5. Nose-plier
6. Plier
7. Emery paper
8. Binding wire 14 SWG T.C.

CIRCUIT DIAGRAM:

(See diagram at the end)

PROCEDURE

1. Take two short lengths of bare copper conductor (say 8 S.W.G.) each of 20 cms.
2. Clean the short length with the help of emery paper and make them straight.
3. Bend both the pieces at one end and at right angles, about 1.5 cm as shown in the figure ....
4. Hold the lengths togdher in vice or pliers, keeping bends opposite to each other,
5. Bind the joint with binding wire in the overlap fashion. The length of overlap depends upon the diameter of conductor.
6. Cover the complete joint with binding wire.

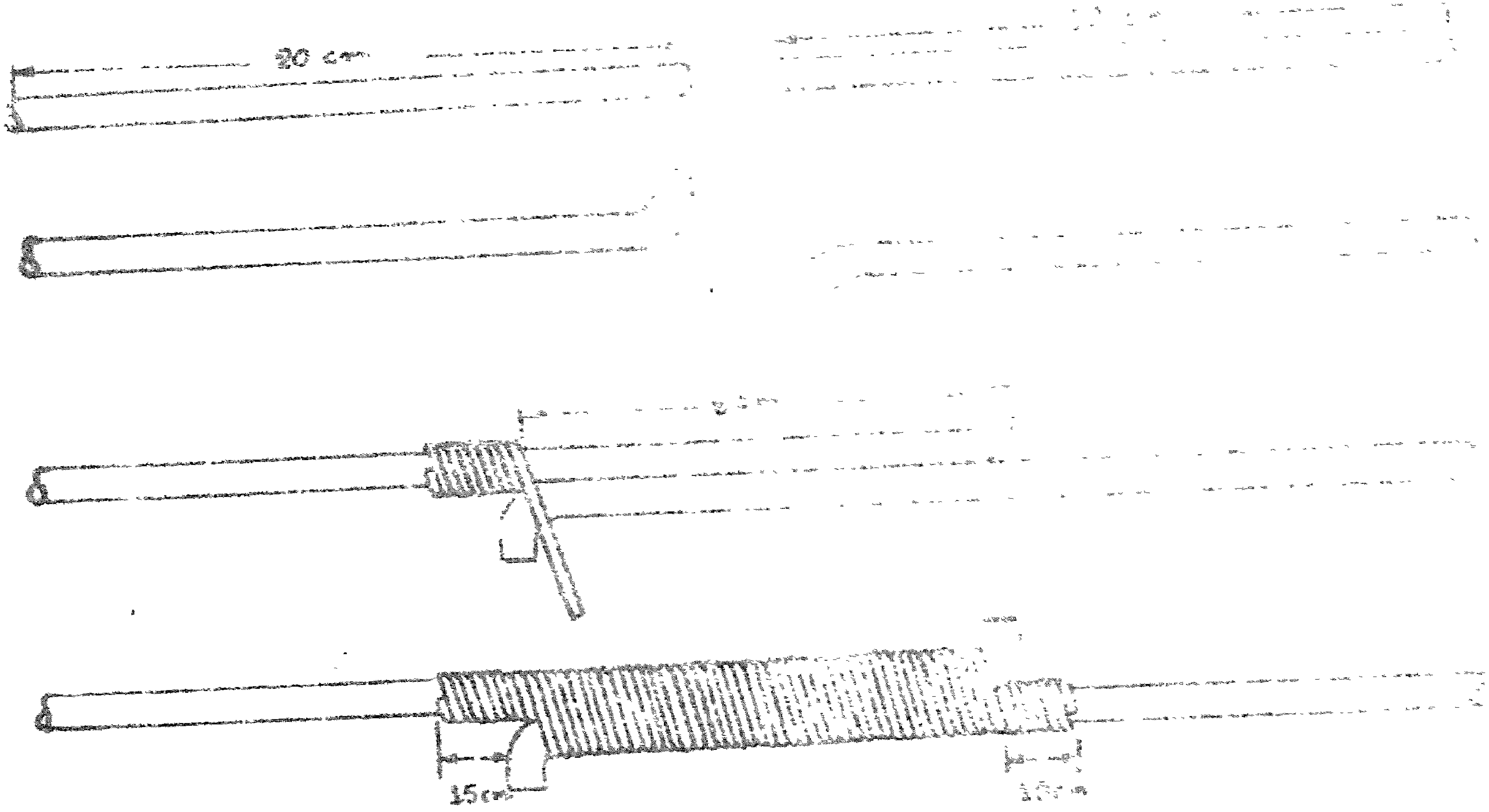
PRECAUTIONS:

1. The wires should be cleaned at the ends properly.
2. The bends should be opposite to each other.
3. The binding wire should go beyond the bends on both side

QUESTIONS FOR EVALUATION:

1. Why the joints are necessary ?
2. Where this joint is used ?
3. What will happen if the joint is loose ?

BRITANNIA JOINT



EXPERIMENT/PRACTICAL NO: 17

TITLE OF EXPERIMENT/PRACTICAL

Making a Western Union Joint.

SPECIFIC OBJECTIVES:

1. To understand the use of a Western Union Joint.
2. To actually make the western joint with (a) Copper conductor, (b) Steel wires (c) Aluminium conductors.

INTRODUCTORY INFORMATION AND RELATED THEORY:

This joint is used to increase the length of bare conductors.

EQUIPMENT AND MATERIAL:

1. Copper conductors
2. Aluminium conductors.
3. Steel wires
4. Knife.
5. Nose-plier
6. Plier
7. Emery paper

CIRCUIT DIAGRAM

(As shown in figure No.17.1)

PROCEDURE

1. Take two equal short lengths of bare conductor (say 8 S.W.G.) each of 40 cm.
2. Clean the short length of wire with the help of emery paper and place them in a position shown in the figure.
3. Leave about 8 cm portion in the centre overlapping.
4. Hold the lengths together in a vice or pliers.
5. Give required turns and twist to one conductor around the other making 3 to 5 turns.
6. The process is repeated for the other side.
7. The surplus wire should be removed.
8. Finish the joint with the help of the plier.

PRECAUTIONS

1. The wires should be cleaned at the ends properly.

2. The joint should be mechanically sound.
3. The surplus wire should be removed.

QUESTIONS FOR EVALUATION:

1. Where this joint is used ?
2. What will happen if the jointis not sound mechanically

WESTERN UNION JOINT

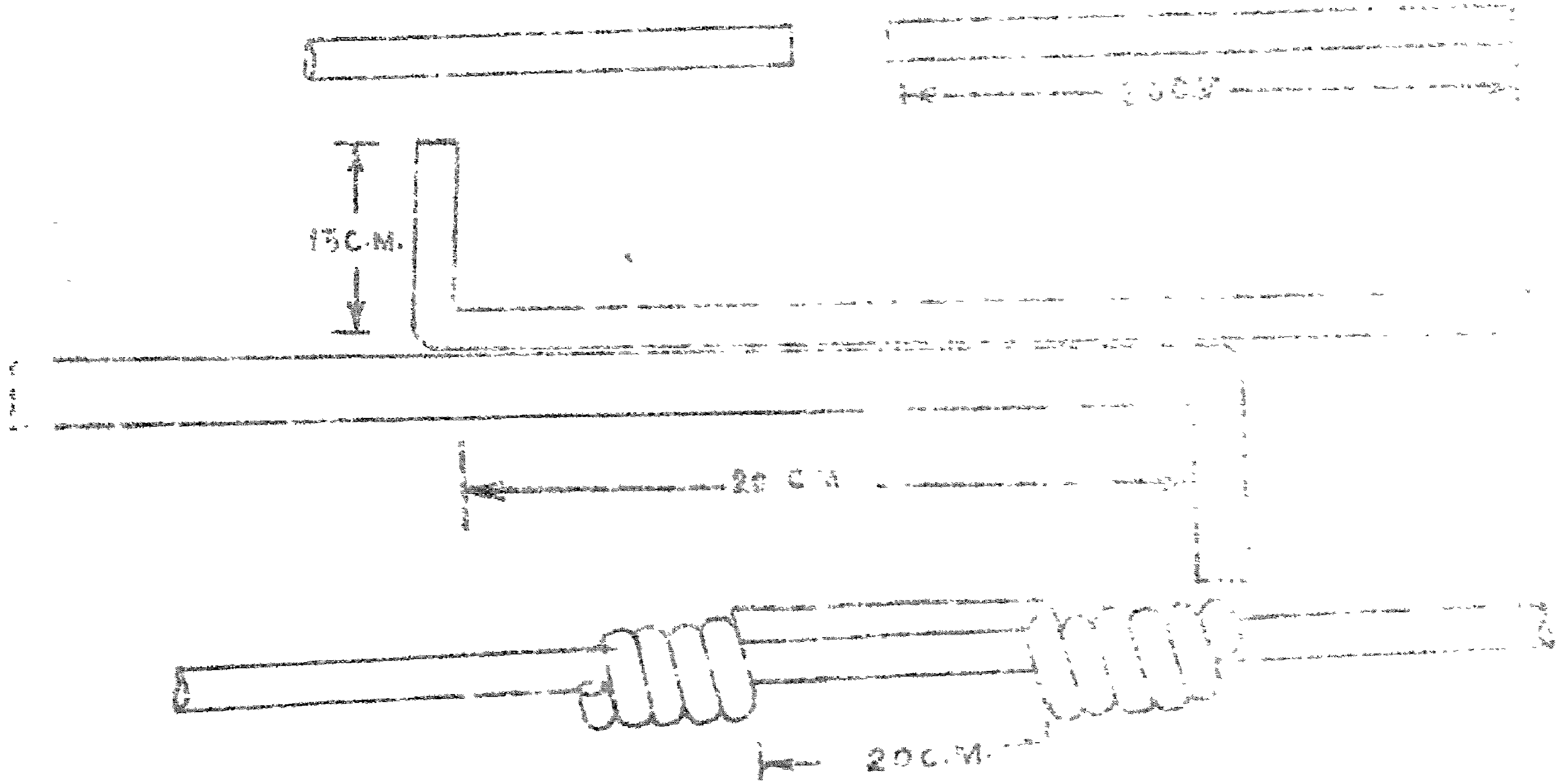


Fig No. 73

EXPERIMENT/PRACTICAL NO : 18

TITLE OF EXPERIMENT/PRACTICAL :

Making a T-Joint.

SPECIFIC OBJECTIVES :

1. To understand the use of a T-joint.
2. To actually make the T-joint with (a) copper wire, (b) Steel wire, (c) Aluminium wire.

INTRODUCTORY INFORMATION AND RELATED THEORY:

This joint is used to take an extension from a straight supply line. The extension may be taken in one or more directions.

EQUIPMENT AND MATERIALS :

1. Copper conductors,
2. Aluminium conductors,
3. Steel wires,
4. Knife,
5. Nose plier,
6. Plier,
7. Emery paper.

CIRCUIT DIAGRAM:

(as shown in figure No. 18.1)

PROCEDURE:

1. Take two short lengths of bare conductor (say 8 S.W.G.) of about 80 cm length and 60 cm for taping(vertical length).
2. Clean the lengths with the help of emery paper and make them straight.
3. Bend the length of 60 cm at one end of right angle about 1.5 cm.

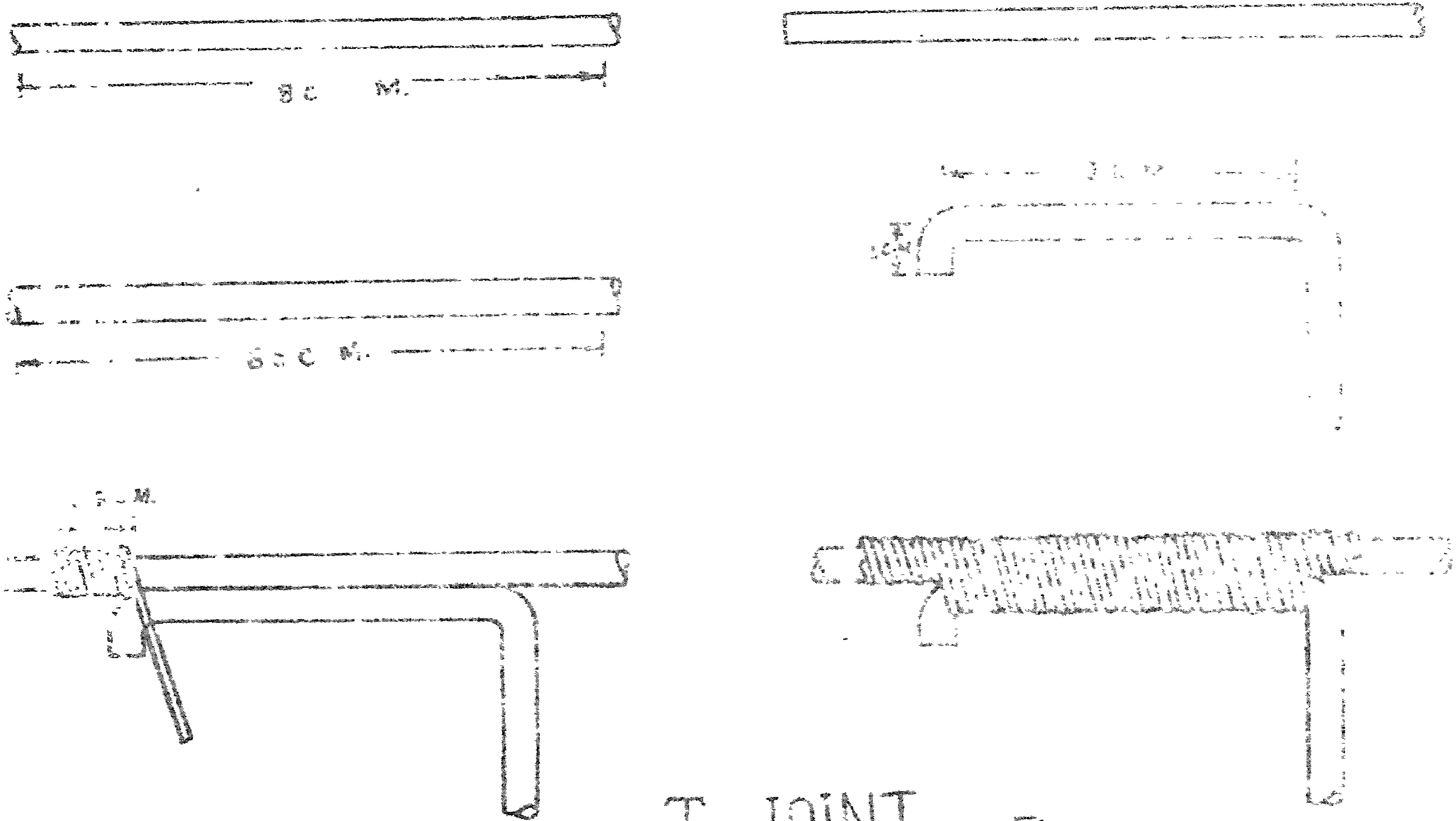
4. Again bend the above length keeping 8 cm distance at 90° exactly. This length will be used for vertical (taping) purpose.
5. Hold the length together in a vice or pliers in a positi
6. Bind the joint with binding wire in the fashion as shown in figure.

PRECAUTIONS :

1. The wires should be cleaned at ends properly.
2. The bends should be placed lightly with the line.
3. The binding wire should go beyond the joint on both sides of the vertical tap.

QUESTIONS FOR EVALUATION:

1. Why this joint is necessary?
2. What will happen if the joint is loose?
3. Why the binding wire is having less diameter as compared to the main wire?



T JOINT Fig 31

EXPERIMENT/PRACTICAL NO: 19

TITLE OF EXPERIMENT/PRACTICAL

Connection of a Fluorscent Tube with A.C.Supply.

SPECIFIC OBJECTIVES:

To acquaint the students with the operational principles of a fluorescent tube and method of connection.

INTRODUCTORY INFORMATION AND RELATED THEORY

Fluorescent tubes consist of glass tubes fitted with two filaments and neon gas at a very low pressure. The inside of the glass tube is coated with a fluorescent material which helps to produce brighter illumination than tungston lamps having same power consumption.

The low pressure gas inside the tube requires an initial high voltage to allow a conduction path. Single phase supply voltage available in our country (i.e.230V, 50 c/s) is not sufficient to ignite these tubes. For this purpose a starting element known as a starter and a choke coil are used. These two units help to produce enough high voltage across the electrodes initially to make the low pressure gas conductive. Once the gas begins conducting the conduction is sustained at the normal supply voltage.

The power rating of a fluorescent tube depends on the length of the tube, that is, on the separation distance of the electrodes. The following table gives an idea:

Length- wattage
1.5 ft - 15
2.0 ft - 20
4.0 ft - 40
5.0 ft - 80
6.0 ft - 125

A condenser should be put across the supply to improve the power factor and reduce flickering.

EQUIPMENT AND MATERIALS

Item	Range or Rating	No.
1. Fluorescent tube	230 V, 50c/s, 40 w	1
2. Choke coil	230v,50c/s, 40 w	1
3. Starter	230v, 50c/s, 40 w	1
4. Tube holders	according to the tube size	2
5. Condenser	230v, 50c/s,5 microfarad	1
6. Flexible wire		required length
7. Screw-driver	15 cm.	
8. Connector screw driver		1
9. Poker		
10. Hand drill machine		1
11. Electrician knife		1
12. Wood screws	34,30 20 mm	

CIRCUIT DIAGRAM:

The circuit diagram is shown in Fig.1

PROCEDURE

a) Connect the circuit as shown in Fig.1

b) The phase wire should be connected to the tube through the choke coil. The neutral wire should go straight to the tube.

c) The starter should be connected across the tube.

d) The condenser should be connected in parallel to the supply.

TABULAR RECORD OF OBSERVATION

a) After the connection is over switch on the mains and observe the tube glowing.

b) Switch off the mains and short the startner terminals. Switch on the supply again and observe that the tube is not glowing.

PRECAUTIONS:

a) The choke should always be connected in series and the capacitor should always be connected in parallel.

b) Connection should be made firmly.

QUESTIONS FOR EVALUATION:

1. Why the starter and choke coil are needed in a fluorescent tube ?

2. Why does a fluorescent tube gives brighter illumination compared to a tungsten lamp of same wattage ?

3. Why a capacitor should be used in a fluorescent tube connection ?

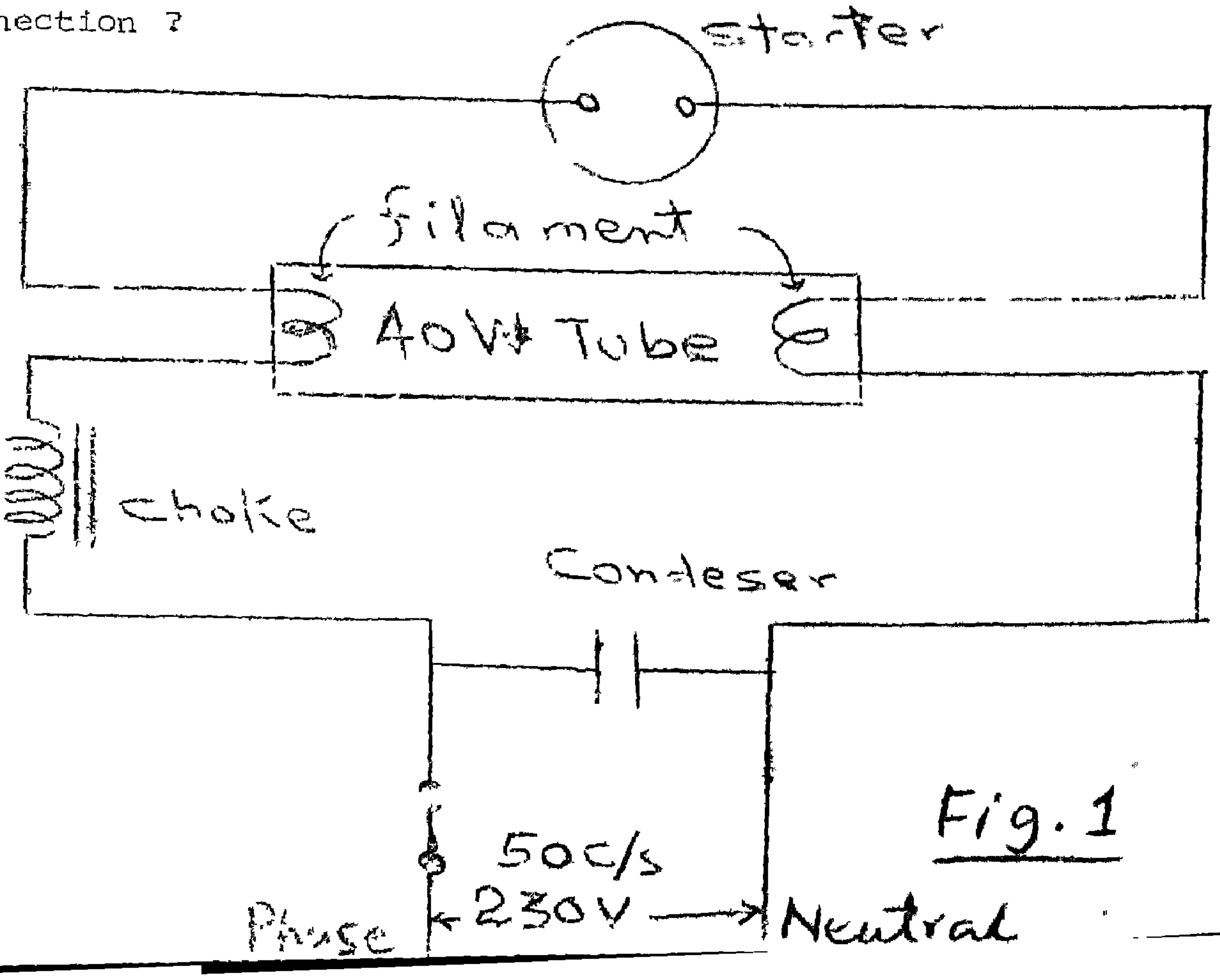


Fig. 1

EXPERIMENT/PRACTICAL NO: 20

TITLE OF EXPERIMENT/PRACTICAL

Marking of vertical and horizontal lines on the wall using plumb-bob and Thread.

SPECIFIC OBJECTIVES:

At the end of this excercise, the learner should be able to :

1. Handle the plump-bob and Thread correctly.
2. Mark the vertical and horizontal line points as per the wiring diagram (Minimum two points one on top and the other at bottom of each line and one at each end of the wall horizontally).
3. Draw the vertical lines by joining the marked points (using anychalk powder) by means of a thread.
4. Draw the horizontal lines by joining the marked points.

INTRODUCTORY INFORMATION AND RELATED THEORY

In all the types of wirings, various wiring materials such as T.W.boards and blocks are to be fixed on walls to fix accessories on them. In order to have a good appearance of the wiring in any place, it is necessary to maintain the straight lines as far as possible. Hence it is necessary to mark the paths of electrical lay outs before starting the actual wiring on the walls, for this the simplest method is by using a wireman's hand tool called plumb-bob with thread alongwith any coloured/ white chalk powder.

EQUIPMENT AND MATERIALS

Hand tools :-. 1. M.S./Brass plumb-Bob with hard thread.

Raw materials:-. 1. White/coloured chalk powder

2. Any vessel to keep the chalk powder.

CIRCUIT DIAGRAM:

(diagram attached)

PROCEDURE

1. Study the given wiring diagram carefully.
2. Arrange tools and materials.
3. Wet the chalk powder in the vessel.
4. Dip the thread of the plumb-Bob into the wet-chalk powder vessel thoroughly.
5. Hold the wooden metallic block of the plumb bob with one hand on the top of the wall.
6. Allow the plumb-bob (Round metallic body) towards ground position of the wall through thread.

7. Wait for plumb-bob's dead position i.e. to come to its rest position.
8. Mark the vertical line by pulling the thread once away from the wall and leaving the same to touch the wall clea
9. Remove the plumb-bob and mark the required line points vertically on the chalk-line of the wall.
10. Similarly mark for horizontally also.

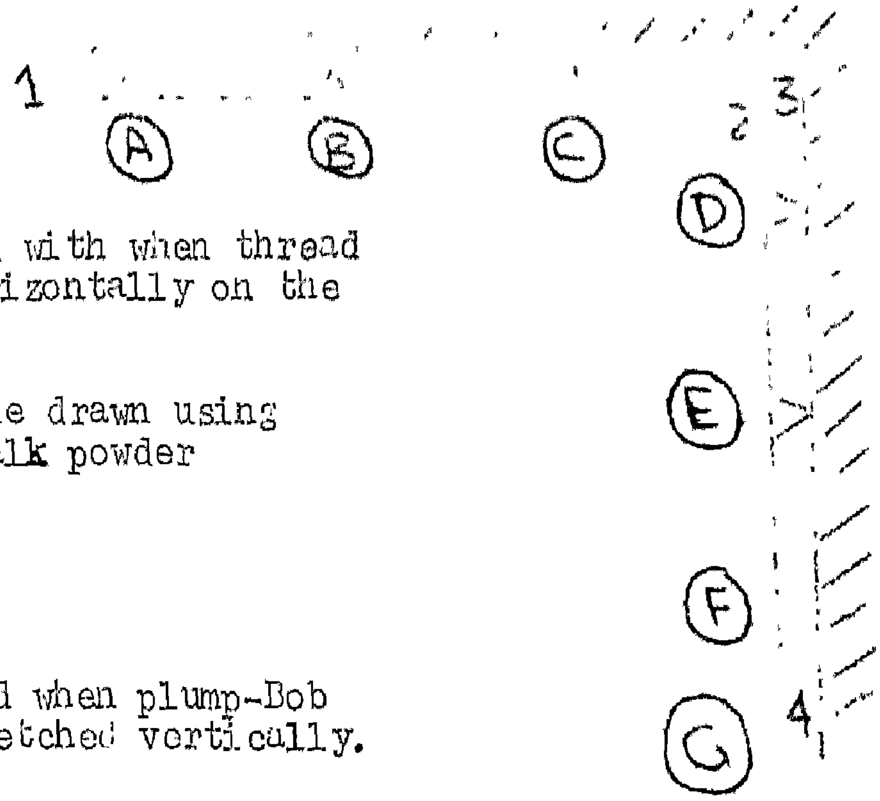
PRECAUTIONS

1. Avoid doublingof the lines.
2. Donot drop the plumb-bob.
3. Avoid knots in the thread.
4. Use any bright colour for marking.

QUESTIONS FOR EVALUATION

1. How do you use a plumb-bob for marking vertical lines ?
2. How do you use the thread for marking horizontal lines ?
3. Why bright colours are used for marking ?

LAYOUT DIAGRAM:



A.B.C- Points marked with when thread stretched horizontally on the wall.

1-2 - Horizontal line drawn using thread and chalk powder

G - Plumb- bob

3-4 Thread

D.E.F. points marked when plump-Bob & thread stretched vertically.

EXPERIMENT/PRACTICAL NO: 21

TITLE OF EXPERIMENT/PRACTICAL :

Marking the position of T.W. Boards and Round Blocks on the wall.

SPECIFIC OBJECTIVES :

At the end of this exercise, the learner should be able to:

1. Study the layout diagram carefully.
2. Mark the correct positions of the T.W. Boards and round blocks as per the layout diagram.

INTRODUCTORY INFORMATION AND RELATED THEORY :

In the field of domestic and industrial wirings, many controlling switches are to be provided at convenient places for the purpose of easy and safe operation of the various electrical apparatus/appliances. All these controlling switches are to be mounted on either T.W. round blocks or on T.W. boards of proper sizes. So it is necessary to identify the correct positions of various T.W. Boards and blocks.

EQUIPMENT AND RAW MATERIALS :

Hand Tools. 1. Wooden foot rule four fold 600 mm
2. Try square 150 mm
3. Plumb bob M.S./Brass with thread
4. Pocker/Bradawal 150 mm

Raw Materials: 1. T.W. Board of available sizes.
2. T.W. Round blocks 90 mm dia.
3. Coloured pencil/black lead pencil.

Layout Diagram: This should be demonstrated by the Instructor by actually taking a small wiring layout in the shop.

PROCEDURE:

1. Mark the wiring/layout diagram on the wall with the help

of plumb bob.

2. Mark the sizes of the boards/blocks with the help of foot rule and try square.

3. Mark the positions of T.W./gitties for fixing the T.W. Boards/blocks.

SAFETY PRECAUTIONS

1. All the tools should be used carefully.

2. The positions of the boards/blocks should be marked as per the dimensions given.

QUESTIONS FOR EVALUATION :

1. Why marking of boards and blocks on the wall is necessary?

2. How do you mark the positions of gitties for fixing T.W. boards/blocks?

EXPERIMENT/PRACTICAL NO 22

TITLE OF EXPERIMENT/PRACTICAL:

Fixing of gitties by using a chisel & a Hammer.

SPECIFIC OBJECTIVES:

At the end of this exercise the learner should be able to:

1. Mark on the walls the position of fixing of gitties.
2. Make the holes on the positions marked with Chisel & Hammer.
3. Fix the wooden gitties by both loose and tight methods.

INTRODUCTORY INFORMATION AND RELATED THEORY:

The battens, conduits, T.W round blocks and boards are to be fitted on the walls, while doing wirings. These items cannot be nailed to the walls. To fix them we have to provide a wooden box in the concrete walls or roofs such that wooden screws can be driven firmly. Hence practice of fixing of wooden plugs generally known as gitties is essential.

EQUIPMENT AND MATERIALS:

Tools: 1. Cold Chisel 150 mm
2. B.P. Hammer 1 kg.

Raw Materials : 1. Wooden gitties
2. Cement.

Layout Diagram;

(See fig. a,b & c)

PROCEDURE :

1. Mark on the walls for fixing of gitties according to batten lengths, and also the positions of Round

blocks and boards.

2. Mark on the ceiling roof for fixing batten, and other blocks.
3. Mark Cross lines before making the holes as per fig (a).
4. Mark a square keeping in view the sizes of wooden plugs.
5. Take a Cold chisel and hammer, make a hole in the Walls.
6. Fix the plug as shown in fig. (b) and fill up wit Cement.
7. Fix the plug as shown in Fig.(c) for tight plug fixing.
8. Allow some time to dry up, provide water for cement to setting.

PRECAUTIONS·

1. Mark on the wall correctly according to the size of wooden plug.
2. Take care about plastering on roof.
3. Mix cement and sand in proper ratio.
4. Use proper tools for proper works.

QUESTIONS FOR EVALUATION:

1. How do you mark the positions of gitties on walls?.
2. Which method of fixing of gitties is preferred and why?
3. Why cement is used while fixing gitties?

NOTE : This exercise can only be done on walls.

LAYOUT DIAGRAM:

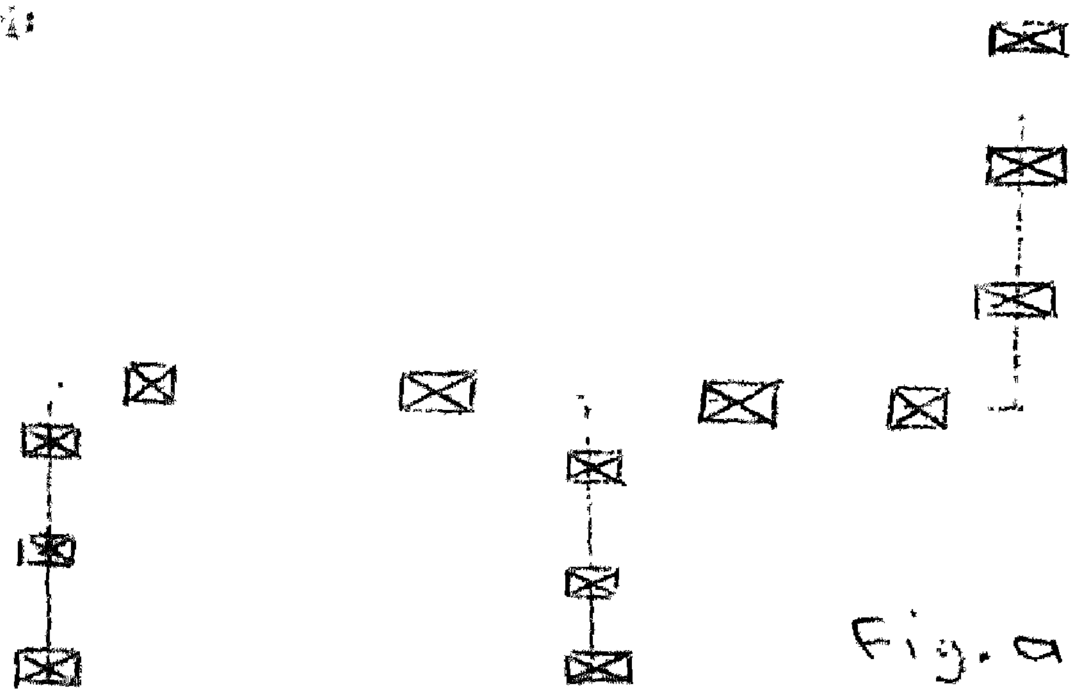


Fig. a

Marking a cross line before making the hole for housing the plug to centre it.

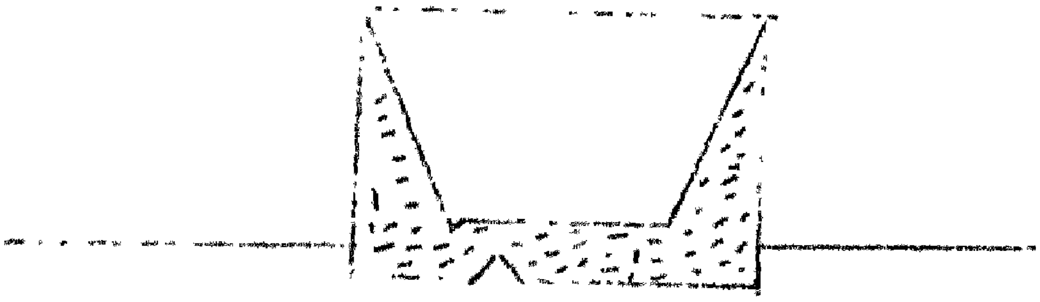


Fig. b

Wooden plug fixed in the Wall with Concrete Mixture and Granite Pieces.

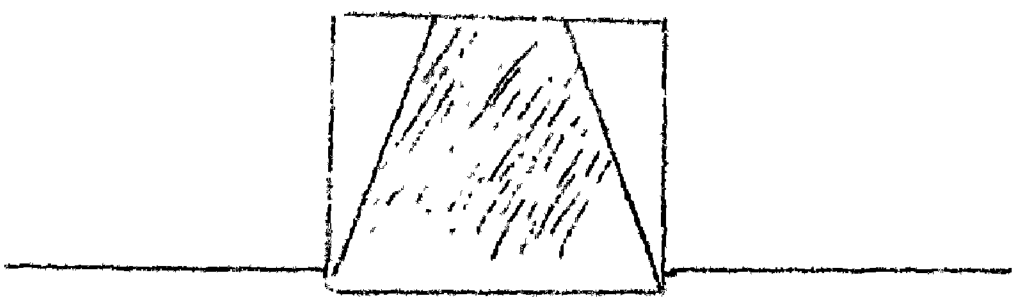


Fig. c

Wooden plug fixed in the Wall tight plug.

EXPERIMENT/PRACTICAL NO: 23

TITLE OF EXPERIMENT/PRACTICAL

Fixing of Rawl plug and compound using Rawl tools and bits.

SPECIFIC OBJECTIVES

At the end of this excercise the learner will be able to :

1. Mark for the positions for making holes to fix rawl plugs.
2. Drill a hole by using rawl tool and bit.
3. Fix the plug or compound in the holes made.

INTRODUCTORY INFORMATION AND RELATED THEORY

Use of wooden plugs in the walls for fixing up the batten or round blocks involves more labour and time; and also spoils the walls. Hence a new technique with a minimum time and labour is essential. The use of rawl tools & plugs provides the same. Here different sizes of rawl tools and holders are available in the market; Rawl plugs made of fibre materials also available in the same number. Select both of them of same size for use, instead of rawl plugs, filling compound is also available and can be used.

EQUIPMENT AND MATERIALS

1. Rawl tool 8,10,12,14,18,20,22,24 as available.
2. Rawl bits 8,10,12,14,18,20,22, 24 as available.
3. B.P. Hammer 1 kg and 1/2 kg.

Raw Materials

1. Rawl plugs of above size according to bit.
2. Filling Compound.
3. Wood screws of different sizes as required.

CIRCUIT DIAGRAM

(See fig.1)

PROCEDURE

1. Mark on the walls and roofs, the position of fixing Rawl plugs according to length of batten and position of the blocks etc.
2. Select the correct size of tools and holder according to job.
3. Drill a hole in the wall by Rawl tools and Hammer to the length equal to Rawl plug size.
4. Take a Rawl plug (Soaked in water) and keep it in the hole and fix the block or batten with wood screws.
5. In case of using filling compound, mix up the dry compound with water.
6. Prepare the filling compound into cylinderical shape to the size of holes.

7. Insert the compound into the holes made.
8. Fix the batten/blocks with screws in the compound.
9. Allowe/some time to dry up.

PRECAUTIONS

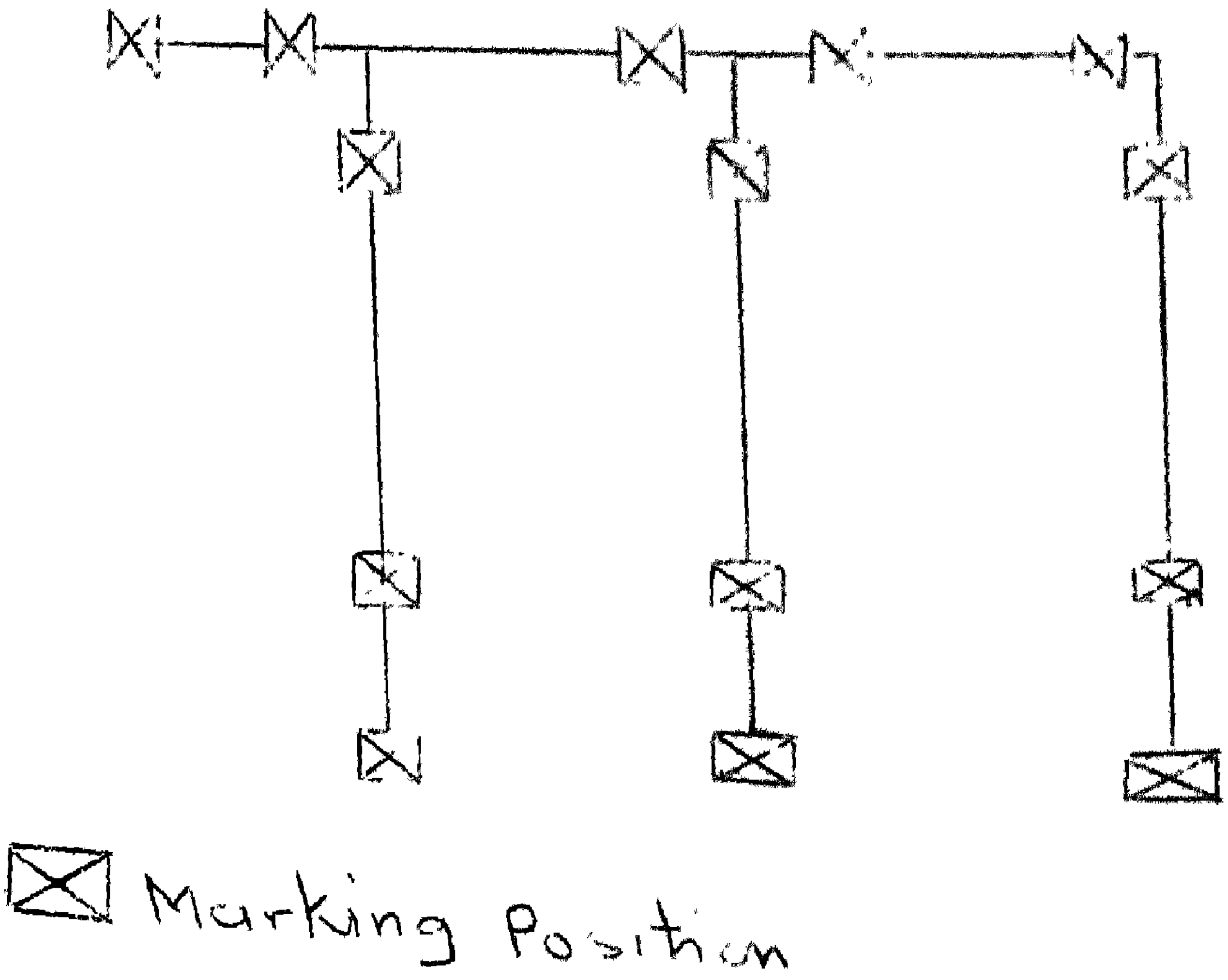
1. Select correct size of tools and bit for correct job.
2. Rotate the Rawl tool at every stroke of hammer.
3. Dip the plugs in water before using.

QUESTIONS FOR EVALUATION:

1. Why should we rotate the rawl tool while using ?
2. What will be the size of rawl tool to be used with 10 Rawl plug ?
3. While using compound what care is to be taken ?

Note: This excercise should be practised only on walls.

Layout Diagram:



EXPERIMENT/PRACTICAL NO: 24

TITLE OF EXPERIMENT/PRACTICAL

Practice of marking Round blocks and boards for fixing of electrical accessories.

SPECIFIC OBJECTIVES:

At the end of this exercise the learner shall be able to:-

1. Select correct size of board/block for accessories.
2. Arrange the layout on the board for accessories.
3. Mark for each accessories on the block/board.
4. Drill the holes according to marking for wire;

INTRODUCTORY INFORMATION AND RELATED THEORY:

The electrical accessories are fitted on wooden blocks and boards in actual wiring. These accessories are to be properly arranged such that the general appearance of wiring will be good and able to use the space available economically.

EQUIPMENT AND MATERIALS:

Tools:

(1) Steel Rule 300 mm

(2) Screw driver insulated 150 mm.

(3) Hand drill m/c & 6mm bit.

(4) Pocker/Breadawl. 150 mm.

(5) Screw driver Insulated 100 mm.

Raw Materials :

(1) Wooden boards as available.

(2) Round blocks 90 mm dia.

(3) SPT Switch, Batton Holder, Ceiling Rose.

(4) Chalk Powder.

Layout Diagram

(see fig. a & b)

PROCEDURE :

Arrange all the materials.

A Marking on a Round block

1. Find out the centre of the Round block and mark the centre as in Fig. a
2. Keep the switch in the centre of the block.
3. Unscrew the terminal screws by using screw driver of 100 mm.
4. Take the chalk powder and pour [illegible] terminal holes.
5. Also pour the chalk powder on the [illegible] the switch is to be fitted with screws.
6. Slowly lift the switch.
7. Mark with pencil the centre where [illegible] chalk powder is collected.
8. Drill the holes on the markings [illegible] terminals.
9. Make a mark with chalk on the [illegible] chalk powder where the switch is to be fitted.

The same procedure can be repeated for [illegible] ceiling rose etc.

Marking on a Wooden Board:

1. Mark the lines on board as shown in Fig. [illegible] to identify the different centres.
2. Arrange the accessories (lay the accessories) such that the switches will be in bottom and fuses will be in bottom and fuses will be in top and so on.
3. Remove the top covers of switches, Wall sockets etc.
4. Mark with chalk powder as done above.
5. Drill the holes with drill machine.
6. Mark the positions for fixing the screws.

Keep the fuse cut out and Repeat the same operations.

PRECAUTIONS

1. Avoid unnecessary handling of porcelain based accessories.
2. Use proper tools for proper work.
3. Don't disturb the positions of the accessories while pouring the chalk powder.
4. Use correct size of wood screws.

QUESTIONS FOR EVALUATIONS :

1. How do you find the centre of the Round block?
2. Why chalk powder is used for marking?
3. How do you arrange the accessories on the board?

Layout Diagram.

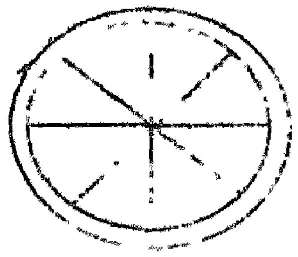


Fig. a: For a Round block

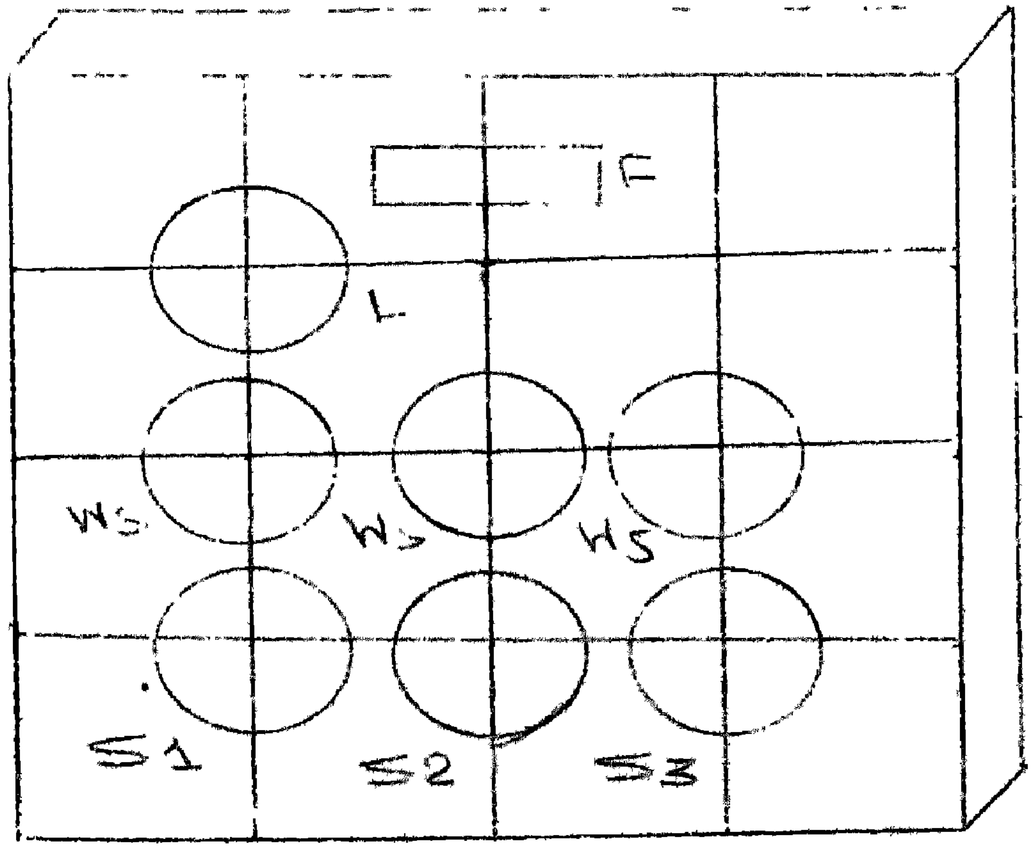


Fig. b: For a Board

EXPERIMENT/PRACTICAL NO.25

TITLE OF EXPERIMENT/PRACTICAL

Practice of fixing of various boards and blocks.

SPECIFIC OBJECTIVES.

At the end of this excercise the learner should be able to :

1. Mark the positions of boards and blocks for any wiring.
2. Mark the holes on the board for fixing.
3. Fix the boards/ blocks as per marking.

INTRODUCTORY INFORMATION AND RELATED THEORY

Once the layout is marked for wiring both vertical and horizontal positions, the position for the boards/ blocks are also marked so that wooden gitties or rawl plugs are fitted. The boards/ blocks should be properly fitted on the gitties already provided.

EQUIPMENT AND MATERIALS

Tools:

1. Screw driver insulated 300 mm.
2. Screw driver insulated 240 mm.
3. Socker/ Bradawl-150 mm.

Raw Materials.

1. Wooden boards and blocks.
2. Wood screws 30 mm, 50 mm.

CIRCUIT DIAGRAM

The Instructor should give a live demonstration as per the place of wiring needed.

PROCEDURE

1. Arrange all the materials.
2. Open the top cover of the board.
3. Keep the lower part of the board on the wooden gitties and mark with pencil from top and side lines to find the centre.
4. Make a hole on the centre of the lines on board.
5. Fix the board with suitable screws.
6. For a round block find the centre and drill a hole or otherwise drill holes at equal places from the centre.
7. This can be done only as per the gitties positions.
8. Place the round block in position and tighten the screws.

PRECAUTIONS

1. The boards should be fitted straight.
2. Avoid tilting of boards/blocks.
3. Core should be taken to avoid damage to board/block while fixing with screws.
4. Fix all the screws where markings are provided.

QUESTIONS FOR EVALUATION:

1. How do you mark the position of the boards/blocks ?
2. How do you mark the holes on board for fixing ?

Note: The instructor can provide practice in actual wiring situations either in Houses or halls etc.

EXPERIMENT/PRACTICAL NO: 26

TITLE OF EXPERIMENT/PRACTICAL:

Fixing of Tumbler switches and flush type switches on blocks and boards.

SPECIFIC OBJECTIVES:

At the end of this exercise the learner should be able to:

1. Select the proper size of boards/blocks.
2. Arrange the switches on the board in positions.
3. Fix the switches in positions marked on the blocks/ boards.

INTRODUCTORY INFORMATION AND RELATED THEORY:

Main switches are used for controlling the supply i.e. both phase and neutral, whereas one light fan or plug socket is to be controlled independently, tumbler switches or flush type switches are most commonly used in domestic installation.

EQUIPMENT AND MATERIALS:

Hand tools :

1. Foot rule four fold 600 mm.
2. Try square 150 mm.
3. Pocker/Bradawl 150 mm.
4. Hand drill/power drill machine with suitable drill bit.
5. Screw drivers insulated 150 and 100 mm.
6. Firmer chisel set of three, 25, 12, 6 mm.
7. Wooden mallet.
8. Wood rasp file half round as required.

Raw materials.

1. T.W. board and round blocks as available.
2. S.P.T. switches.
3. Flush type switches as available
4. Wood screws 20 mm
5. Machine screws 10 mm x 2 mm.

Layout Diagram.

The instructor should demonstrate the fixing of switches on board/block.

PROCEDURE :

1. Arrange all the tools and materials.
2. Take a round block of 90 mm dia,
3. Keep the switch in the centre,
4. Fix the switch with the help of wood screws on the markings already done.
5. Take a board of 100 x 100 mm.
6. Put the flush type switch in the centre of the board and work the position with pencil/sharp poker.
7. Remove the switch.
8. With the help of firmer chisels cut the inside wooden portions on the block (within the marked lines only).
9. Place the switch on the centre of the board (in the groove already made) for marking position of fixing screws.
10. In case any difficulty for placing the switch in the cut groove, finish with the help of rasp file.
11. Fix the switch with help of machine screws.

PRECAUTIONS :

The groove should be cut according to the size of the switches.

2. Keep the switches straight and tight.

QUESTIONS FOR EVALUATION:

1. What is the difference in general appearance of tumbler switch and flush type fixing?
2. How do you mark the position for flush type switch?

EXPERIMENT/PRACTICAL NO: 27

TITLE OF EXPERIMENT/PRACTICAL

Fixing of various iron clad switches on boards.

SPECIFIC OBJECTIVES

At the end of this excercise the learner shall be able to :

1. Select the correct size of boards according to given switches.
2. Arrange the switches on the board to cover the maximum area of the board.
3. Fix the switches on the boards firmly.

INTRODUCTORY INFORMATION AND RELATED THEORY

The lineman has to handle a number of switches in the field. Main switches of different shape, size and types are used. The purpose of the main switches is to control the entire supply. One of the examples of main switches is iron clad switches which are available like double pole iron clad , (D.P.I.C) switches Triple pole iron clad (T.P.O.C.) switches etc. This excercise helps the learner to practice the fixing of such main switches.

EQUIPMENT AND MATERIALS

Tools:

1. Driling machine either hand operated or power operated with drill bit of 6mm.
2. Pocker/Bradawal -150mm.
3. Screw driver insulated-200 mm.
4. Screw driver insulated-100 mm.
5. Steel rule- 300 mm.

Raw Materials:

1. Wood screws 20 mm
2. Different IC switches like DPIC 250V, 10A, 15A, 30A, TPIC 500V 15A, 30A 60A.

CIRCUIT DIAGRAM

This should be demonstrated by the instructor by fixing any available switch on suitable board.

PROCEDURE:

1. Arrange all the materials and tools.
2. Select the board according to the switch available.
3. Suppose you have given with 250V 15A DPIC switch select 150 x 200mm board.
4. Keep the main switch in the centre of board.
5. Check up the distance from the main switch end to the board end. Adjust such that same distance is maintained in all directions.
6. Open the cover of the main switch.
7. Mark the points with Broadawl to fix the switch with screws on board.
8. Drill the holes on the board on both sides of switch (top and bottom) for getting incoming supply leads and load leads.

You can repeat the same procedure for any type of IC switches

PRECAUTIONS

1. Use the proper tools for proper operations.
2. The main switches should be fitted tightly.
3. Switches should be fitted in straight line.
4. Burrs after drilling should be cleaned.

QUESTIONS FOR EVALUATION

1. What are the factors to be considered for selecting a board for fixing main switch .
2. Where do you mark for incoming leads ?
3. What precaution will be observed while drilling the holes.

EXPERIMENT/PRACTICAL NO. 28

TITLE OF EXPERIMENT/PRACTICAL

To control of one lamp by one S.P.T. switch in cleat wiring.

SPECIFIC OBJECTIVES

At the end of this excercise the learner should be able to:-

1. Mark the lay-out lines on the wiring board as per the measurements.
2. Fix the porcelain cleats and lay the wires according to the layout marked.
3. Fix and connect the accessories and test the circuit for correctness.

INTRODUCTORY INFORMATION AND RELATED THEORY:

Generally, the cleat wiring is done for temporary purposes in barracks etc. Porcelain cleats of two way or three way are fixed with the help of wood screws. PVC/VIR cables are used in this wiring.

EQUIPMENT AND MATERIALS

Hand Tools

1.	Wooden foot-rule four roll	600 MM
2.	Insulated cutting pliers	150 MM
3.	Insulated side cutting pliers	150 MM
4.	Insulated screw-driver	150 MM
5.	Insulated Screw Driver (Connector type)	100 MM
6.	Electricians knife	100 MM
7.	Pocker/ Bradawl	150 MM
8.	M.S/Brass Plumb Bob with thread	-
9.	Hand drill Machine or power drill machine with drill bit 6mm	-

Raw Materials

1. Porcelain Cleats 2-way
2. T.W.Round blocks 90 MM Dia
3. VIR/PVC cable (Al) 1/1. 5mm^2
4. S.P.T.Switch 5A 250V-Porcelain Base
5. Batten Holder 5A 250V-Brass/Bakelite
6. Wood Screws 50MM,30MM,25MM, 12MM
7. Electric lamp 100 Watt, 250 volts.

CIRCUIT DIAGRAM

(See fig.)

PROCEDURE:

1. Draw the Circuit diagram
2. Arrange tools/ materials
3. Mark the layout on the wiring board as per the measurements given.
4. Fix the cleats as per I.S.I. specifications loosely.
5. Cut the wire into pieces as per the required length.
6. Lay the wires through the grooves of the cleats and tighten the cleats.
7. Mark the positions of the accessories on the round blocks.
8. Drill the holes as per marking on the Round Blocks and fix the accessories on the Round Blocks tightly.
9. Connect the cable ends to the terminals of accessories as per the circuit diagram
10. Give the supply and test the circuit.

TABULAR RECORD OF OBSERVATION

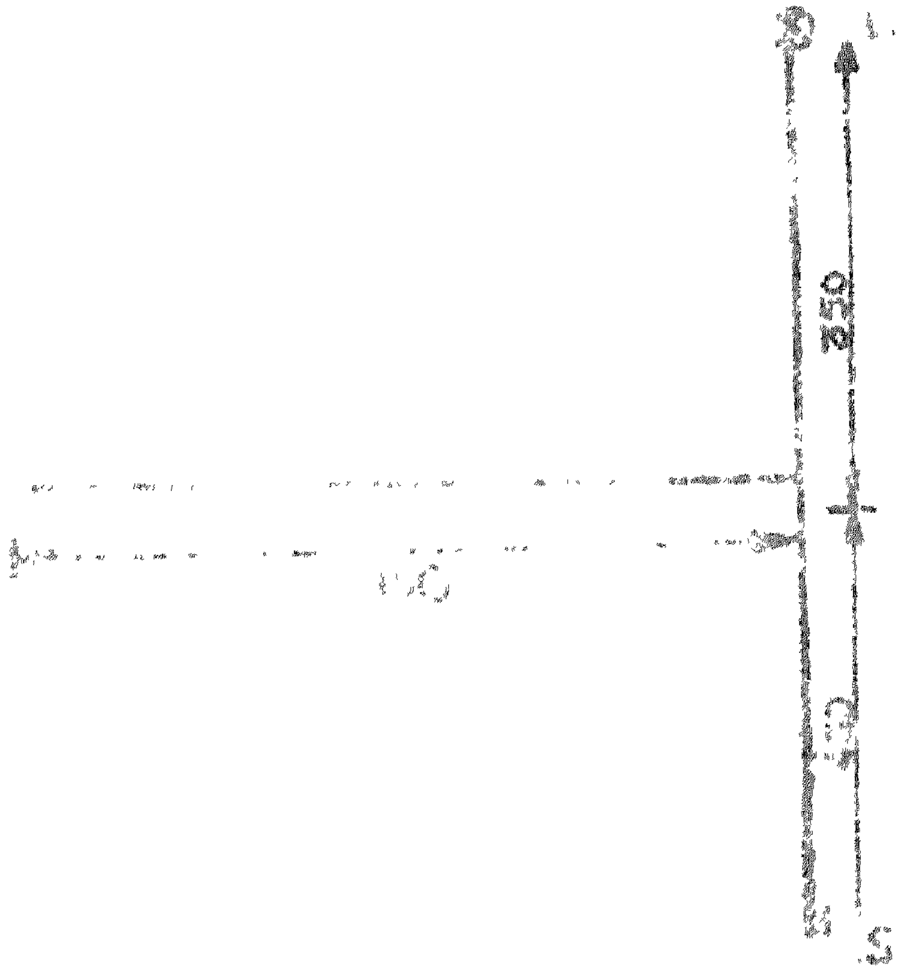
When the switch is 'ON' the light will be bright.

PRECAUTIONS

1. Avoid sharp bends and loose connections of wires.
2. Use proper tools for proper operations.
3. Joints should be avoided in wiring.

QUESTIONS FOR EVALUATION

1. How the layout is marked ?
2. What is the distance between any two cleats [illegible] located in vertical & horizontal positions as per I.S.I specifications ?
3. What precautions are observed while connecting lamp holder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EXPERIMENT/PRACTICAL NO: 29

TITLE OF EXPERIMENT/PRACTICAL

Control of two lamps in series by one switch in cleat wiring.

SPECIFIC OBJECTIVES

At the end of this excercise the learner should be able to :-

1. Mark the layout lines on the wiring board as per the measurements.
2. Fix the porcelain cleats and lay the wire according to the layout marked.
3. Fix and connect the accessories and test the circuit for correctness.

INTRODUCTORY INFORMATION AND RELATED THEORY

Generally the cleat wiring is done for temporary purpose in barracks etc. porcelain cleats of two way and 3 way are fixed with the help of wood screws. PVC/VIR cables are used in this wiring. This particular excercise emphasis the correct connection of two lamps in series, two lamps are connected in series and then connect the positive lead through switch to lamps and negative wire to the lamp. The entire connections will be just like connecting of railway coaches in one row.

EQUIPMENT AND MATERIALS

Hand Tools:

1. Wooden footrule four fold 600 mm.
2. Insulated cutting pliers 150mm.
3. Insulated side cutting pliers 150mm.
4. Insulated screw driver 150 mm.
5. Insulated screw driver. 100 MM
6. Electrician's knife 100 MM
7. Pocker/Broadawl 150 MM
8. MS/Brass Plumb-bob with thread
9. Hand drill machine or power drill machine with drill bit 6mm.

Raw Materials

1. Porcelain cleats 2 way
2. T.W.Round blocks 90 mm dia.
3. VIR/PVC cable al. 1/1.5 mm^2
4. S.P.T.switch 250 V-5A-Porcelain base
5. Batten Holders 5A 250 V Brass/Bakelite
6. Wood screws 50mm,30mm,20mm,12mm.
7. Electric lamp 100 W 250V

CIRCUIT DIAGRAM

(See Fig.)

PROCEDURE

1. Draw the circuit diagram
2. Arrange tools and materials.
3. Mark the layout on the wiring board as per the measurements.
4. Fix the cleats as per I.S.I. specifications loosely.
5. Cut the wire into pieces as per the required lengths.
6. Lay the wires through the grooves of the cleats and tighten the cleats.
7. Mark the position of the accessories on the round blocks.
8. Drill the holes as per marking on the round blocks and b fix the accessories on the round blocks tightly.
9. Connect the cable ends to the terminals of accessories.
10. Give the supply and test the circuit.

TABULAR RECORD OF OBSERVATION

When the w switch is 'ON' both the lights are dim. When one of the lamps removed the other lamp also will not glow.

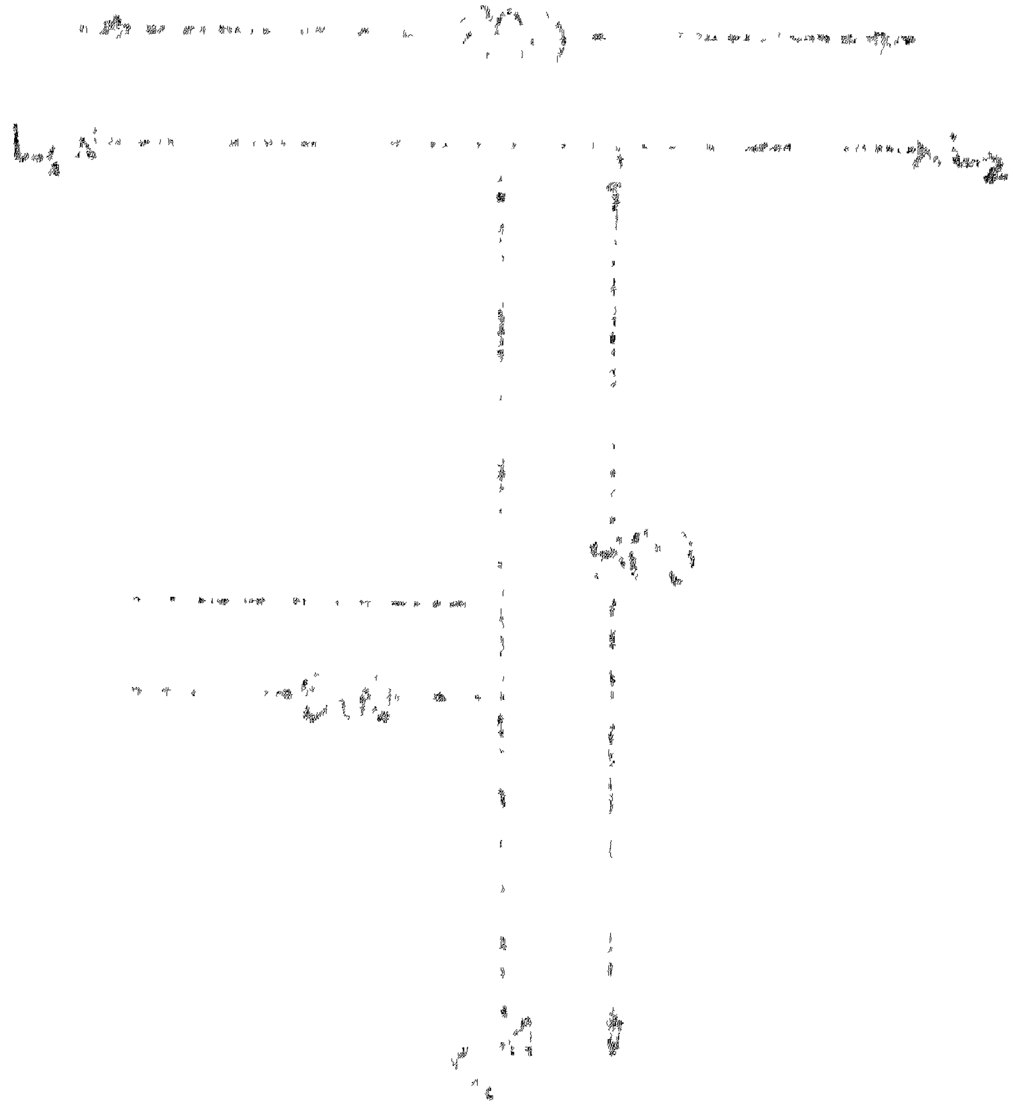
PRECAUTIONS :

1. Avoid sharp bends and loose connection of cable.
2. Use proper tools for proper operation.
3. Joints should be avoided in wiring ?

QUESTIONS FOR EVALUATION

1. Now the lay out is marked ?
2. If 220 V is given, what is the voltage across each lamp of same wattage in this connection ?
3. Why the lamps glow dim in series ?

CIRCUIT DIAGRAM



[illegible]

EXPERIMENT/PRACTICAL NO: 30

TITLE OF EXPERIMENT/PRACTICAL

Control of two lamps in parallel independently by two switches.

SPECIFIC OBJECTIVES

At the end of this excercise the learner should be able to :

1. Mark the layout lines on the wiring boards as per the measurement.
2. Fix the porcelain cleats and lay the wires according to the lay out marked.
3. Fix and connect the accessories and test the circuit for correctness.

INTRODUCTORY INFORMATION AND RELATED THEORY

Generally the cleat wiring is done for temporary purpose in barracks etc. porcelain clats of two way and 3 way are fixed with the help of wood screws. PVC/VIR cables are used in this wiring. In this connection as the two lamps are connected in parallel, even if any one of the lamps is removed the other will function This show that there is more than one path for the current to flow. The phase for the Ist lamp. is taken from the 1st switch control and the phase for 2nd lamp is taken from 2nd switch control. The two switches are linked together.

EQUIPMENT : HANDTOOLS AND MATERIALS.

Hand tools:
(1) Wooden footrule four fold 600 MM
(2) Insulated cutting pliers 150 MM
(3) Insulated side cutting pliers 150 MM
(4) Insulated screw drivers 150, 100 MM
(5) Electricians knife 100 MM
(6) Pocker/Broadawal 150 MM
(7) M.S./Brass plumb bob with thread
(8) Hand Power drill Machine with 6 mm drill bit

RAW MATERIALS :
(1) Porcelain cleats 2 way and 3 way
(2) T.W. round blocks [illegible] mm dia
(3) VIR/PVC cable (Al) 1/1.5 MM^2
(4) SPT switch 5A, 250V porcelain base
(5) Batten Holders Brass/Backelite
(6) Wood screws 50mm,30 mm, 20 mm, 12mm
(7) Electric lamp 100 W 250 V.

CIRCUIT DIAGRAM:

(see Fig.)

PROCEDURE

1. Draw the circuit diagram.
2. Arrange tools and materials.
3. Mark the layout on the wiring board as per the measurement.
4. Fix the cleats as per ISI specifications with wood screws loosely.
5. Cut the cable into pieces as per the required length.
6. Lay the wires through the grooves of the cleats and tighten the cleats.
7. Mark the position of the accessories on the Round-Blocks.
8. Drill the holes as per marking on the round blocks and fix the round blocks tightly, and fix the accessories tightly on round blocks.
9. Connect the cables ends to the terminals of the accessories.
10. Give the supply and test the circuit.

TABULAR RECORD OF OBSERVATION

1) Each lamp is controlled by independent switches.
2) Both lamps are bright and independent as they get full voltage of supply.

PRECAUTIONS:

1. Avoid sharp bends and loose connections of the cable.
2. Use proper tools for proper operations.
3. Joints should be avoided in wiring.
4. The switch must always be connected in the live side of the supply.

QUESTIONS FOR EVALUATION:

1. How the neutral is connected in circuit?
2. If one switch is off and 2nd switch is on, will the lamp one glow or not?
3. What is the size of Round block used?

EXPERIMENT /PRACTICAL NO: 31

TITLE OF THE EXPERIMENT /PRACTICAL

Control of two lamps in parallel by one S.P.T. switch in cleat wiring.

SPECIFIC OBJECTIVES

At the end of this excercise, the learner should be able to :

1. Mark the lay-out lines on the wiring board as per the measurements.
2. Fix the porcelain cleats and lay the wires according to the lay-out marked.
3. Fix and connect the accessories and test the circuit for correctness.

INTRODUCTORY INFORMATION AND RELATED THEORY

Generally the cleat wiring is used for temporary purposes in barracks etc. Porcelain cleats of two way and three way are used and fixed with the help of wood screws. PVC/VIR cable is used in this wiring. In this particular excercise both the lamps are controlled by a single switch by providing phase and neutral wires for both lamps. Even if one lamp is removed, the other will glow in normal way i.e. brightly.

EQUIPMENT AND MATERIALS

Hand Tools:

1.	Wooden Foot Rule four-fold	600 MM
2.	Insulated cutting pliers.	150 MM
3.	Insulated side cutting pliers	150 MM
4.	Insulated screw driver	150 MM
5.	Insulated Screw Driver	100 MM
6.	Electricians Knife	100 MM
7.	Pocker/Bradawal	150 MM
8.	M.S/Brass plumb bob with thread	
9.	Hand /power drill machine with 6 MM Drill Bit.	–

EXPERIMENT/PRACTICAL NO. 32

TITLE OF EXPERIMENT/PRACTICAL:

Practice of fixing of link clips on the batten as per the I.S.I. specifications.

SPECIFIC OBJECTIVES:

At the end of this exercise the learner will be able to:

1. Mark the distances on batten for fixing of link clips as per ISI specifications.

2. Select the proper size of link clips according to the number of wires and sizes.

3. Fix the clips tightly in a St. line.

INTRODUC - INFORMATION AND RELATED THEORY:

The batten wiring is used for house installation and other general purposes. T.W. battens, Round blocks and PVC/TRS/CTS cables are used, but to fix the cables on the T.W. battens, link clips are used. These clips are of tinned copper, brass, or Aluminium made. Practically the arrangement of these clips gives good appearance and also mechanical holding for the cables. According to ISI specifications the clips should be fixed at regular intervals.

EQUIPMENT,HANDTOOLS AND MATERIALS:

Hand Tools: 1. Wooden foot rule fold 600mm.

2. B.P. Hammer with handle 1/4 kg.

Raw materials; 1. T.W. batten 12x12, 20x12, 25x12, 30x12, 35x12, 50x12.

2. Link clips 30 mm, 35 mm, 40 mm, 45 mm and 50 mm.

3. Wire nails 12 mm.

LAYOUT DIAGRAM

(See Fig.)

PROCEDURE:

1. Arrange the tools and materials.

2. Measure the length of the battens given.

3. Mark with pencils on the battens for 15cms and 10 cms according to position of using the batten.

4. Select the size of the clips according to number of wires to be laid on the batten.

5. Keep the eyelid of the clip to the left side of the batten.

6. Drive the nail into the batten in clip centre hold.

7. In case No. of wires are more, use the same size of clips and keep them side by side in two rows such that each clip could hold two/three separate wires.

8. Check up the general appearance, and if needed rub the wires and keep them properly.

PRECAUTIONS:

1. Don't club up more wires in one clip.

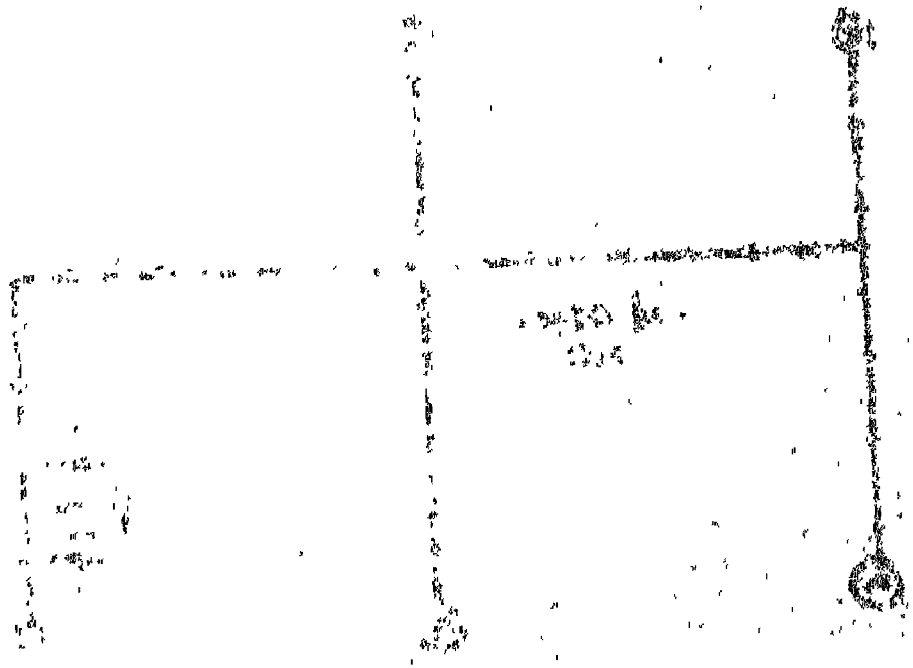
2. Don't use mallet/hammer for tapping of the wires.

3. Joints should be avioded.

QUESTIONS FOR EVALUATION:

1. What is the distance between two clips to be kept in vertical position?

2. What is the distance between two clips to be kept in HORIZONTAL position?



EXPERIMENT/PRACTICAL NO: 33

TITLE OF EXPERIMENT/PRACTICAL

Practice of making various joints on Teak Wood batten.

SPECIFIC OBJECTIVES

At the end of this excercise, the learner should be able to :-

1. Mark on the battens for preparing 'T' joint.
2. Cut the battens according to marking and prepare a 'T' joint.
3. Mark on the battens for preparing Half lap joint.
4. Cut the battens according to marking to prepare a half lap joint.

INTRODUCTORY INFORMATION AND RELATED THEORY

While doing CTS Wiring on T.W.battens for any installation, T.W. battens of different sizes are widely used, on which the cables are laid. According to size of rooms, or situations the battens are to be joined horizontally or vertically, hence necessary for preparing the joints:

EQUIPMENT AND MATERIALS

Tools

1. 4 fold wooden scale 600 mm
2. Tennon Saw. 250 mm
3. Firmer chisels set of three
   6,12 and 20 mm.
4. T.W.Mallet.
5. Wood rasp file 250 mm
6. Try Square 150 mm
7. Hand drill m/c 6 mm.

Raw Materials

1. T.W.battens 12 x 12, 20 x 12, 25 x 12, 30x12
2. Sand paper according to requirements.

PROCEDURE

Prepare a 'T' joint.

1. Cut two lengths of T.W. batten
2. Mark on one of the batten to width of another batten or width side of piece.

3. Repeat the same to another piece also in the centre where joint is to be made.

4. Mark half of thickness on both the pieces on the sides where marking already done.

5. Extend the same marking to all the three sides by the help of Try Square, and two sides for horizontal piece.

6. Cut with a Tennon Saw on the marking on width side to the depth of marking on thickness.

7. Remove that piece with chisel & Mallet.

8. Repeat for the other piece.

9. Place vertical piece on the groove made in horizontal piece.

10. If it is not properly setting, finish with wood rasp file or sand paper.

Preparing a Half Lap Joint.

1. Mark on both the battens on width side equal to size of batten width.

2. Mark half of thickness of batten and extend the same to all the three sides of batten.

3. Cut with Tennon saw on width side to the depth of half thickness already marked.

4. Cut with Tennon Saw on thickness size also and remove the piece, finish with file or sand paper. Repeat for another piece also.

5. Place both the pieces and drive a nail.

PRECAUTIONS:

1. Marking should be done properly.
2. Avoid any gaps between the battens when fitted.
3. Use proper tools for proper operations.

QUESTIONS FOR EVALUATION

1. How do you mark on width side of the batten.
2. Why half of thickness only marked ?
3. Why these joints are prepared while doing T.W. batten wiring ?

EXPERIMENT/PRACTICAL NO: 34

TITLE OF EXPERIMENT/PRACTICAL

Cutting of Round blocks and boards to fix the batten.

SPECIFIC OBJECTIVES

At the end of this excercise the learner will be able to :-

(a) Mark and cut the Round block to fix alongwith T.W.batten of different sizes.

(b) Mark and cut the T.W.boards to fix with T.W.batten of different sizes.

INTRODUCTORY INFORMATION AND RELATED THEORY

The electrical accessories are gnerally fitted on T.W.Round blocks or T.W.boards while doing domestic installations or general wirings. The Round blocks or boards should be cut according to the size of batten used and also the thickness of wires used as you know PVC wires have less overall diameter compared to CTS/TRS wires.

EQUIPMENT AND MATERIALS

Tools

1. Tenon saw 150 mm
2. Firmer chisel set of three 6,12 and 20 mm.
3. T.W.Mallet.
4. Wood rasp file 100 mm.
5. Try square 150 mm.

Raw Materials

1. T.W.Round blocks 90 mm dia.
2. T.W.batten 20x, 12,12x 12, 30x12.
3. T.W. boards 100 x 175 x 250 x 300.
4. PVC/CTS Wire Pieces.

PROCEDURE

1. Arrange all the tools and materials as required.
2. Mark on the round blocks the actual width of the batten sizes.
3. Hold the Round block on vice.

4. Cut with Tennon Saw on the markings given on R.B.

5. Remove the round block from vice and cut and remove the piece with firmer chisel.

6. Fit the batten and in case any difficulty finish with wood rasp file.

7. In case of teak wood board follow the same procedure, but take care to hold the box supporting pieces carefully.

PRECAUTIONS:

1. Marking should be done properly.
2. Avoid sharp edges of the battens at the end.
3. Taper the ends of the batten.
4. Use proper tools for proper operations.

QUESTIONS FOR EVALUATION:

1. How do you mark on the round block for cutting (T.W. batten of 12 x 12) ?
2. What is the care to be taken while cutting T.W.board ?

EXPERIMENT/PRACTICAL NO.35

TITLE OF EXPERIMENT/PRACTICAL

One lamp controlled by one switch on T.W. batten in TRS/CTS/PVC wiring.

SPECIFIC OBJECTIVES

At the end of this excercise the learner should be able to :-

1. Mark the layout lines on the wiring boards as per the measurements.
2. Cut and fix the T.W.batten, alongwith round blocks on the board as per the layout.
3. Fix the link clips as per ISI specifications and lay the cables on the batten.
4. Fix and connect the accessories and test the circuit for correctness.

INTRODUCTORY INFORMATION AND RELATED THEORY

This type of wiring is commonly used for all domestic, and general purposes because of cheapness and better appearance. T.W.battens (fillets) of various sizes are used; this will serve as an insulator between wall & cables. The cables of CTS (CAB TYRE SHEATHED), PVC(POLYVINYL CHLORIDE) or TRS(TOUGH RUBBER SHEATHED) are used.

Tinned clips are used to hold the cables to the battens. These clips are available in various sizes. While doing this type of wiring care should be taken to arrange the clips in a line at an equql distances for better appearance (as per ISI specifications) .

EQUIPMENT AND MATERIALS

Hand Tools

1.	Wooden foot rule four fold-	600 mm.
2.	Tennon Saw,	250 mm

3. Firmer chisel set of 3 Nos. 25,12 and 6 mm
4. Wooden Mallet
5. Hand drill machine or power driven drill machine with drill bits [illegible]
6. B.P.Hammer with handle 1/4 kg.
7. Pocket [illegible] 150mm
8. Insulated cutting pliers 150 mm
9. Insulated side cutter 150 mm
10. Insulated screw drivers 150 mm, 100 mm
11. Electricians knife 100 mm
12. MS/brass plumb-bob with thread.

Raw Materials

1. T.W.batten 12 x 12 mm
2. T.W. round blocks 90 mm
3. CTS/TRS/PVC/ cable 1/1.5 mm^2
4. Link clips [illegible]
5. Wire nails [illegible] No.17
6. T.W. corner 1[illegible] mm (as required)
7. S.P.T. switch 5A 250V-Porcelain base
8. Batten holder brass/ backelite
9. Wood Screws [illegible] 20,12 mm
10. Electfic lamp 100W-250 V.

LAYOUT DIAGRAM.

(See fig.)

PROCEDURE:

1. Draw the circuit diagram
2. Arrange tools/ materials
3. Mark the layout on the wiring board as per the measurements given.
4. Cut the batten according to measurements and prepare necessary joints of batten as per layout and fix the same on the board.
5. Fix the link clips at a distance of 15 cm apart vertically and 10cm apart horizontally.

6. Cut the cable according to measurements and circuit, lay the cables on the batten and tighten with link clips.

7. Cut the round blocks as per batten size and position.

8. Mark for the accessories on round block and drill the holes accordingly.

9. Fix the round blocks, and accessories tightly with the help of wood screws.

10. Connect the accessories as per the circuit diagram.

11. Give the supply and test the circuit.

TABULAR RECORD OF OBSERVATION:

1. When the switch is 'ON' , the light will glow.

2. When the switch is 'OFF', the light will not glow.

PRECAUTIONS:

1. The CTS/TRS/PVC wires should be bent at the radius of 6 times of overall diameter of the cable.

2. Avoid sharp edges on the batten.

3. Keep all the eyelids of the link clips to one side of the batten.

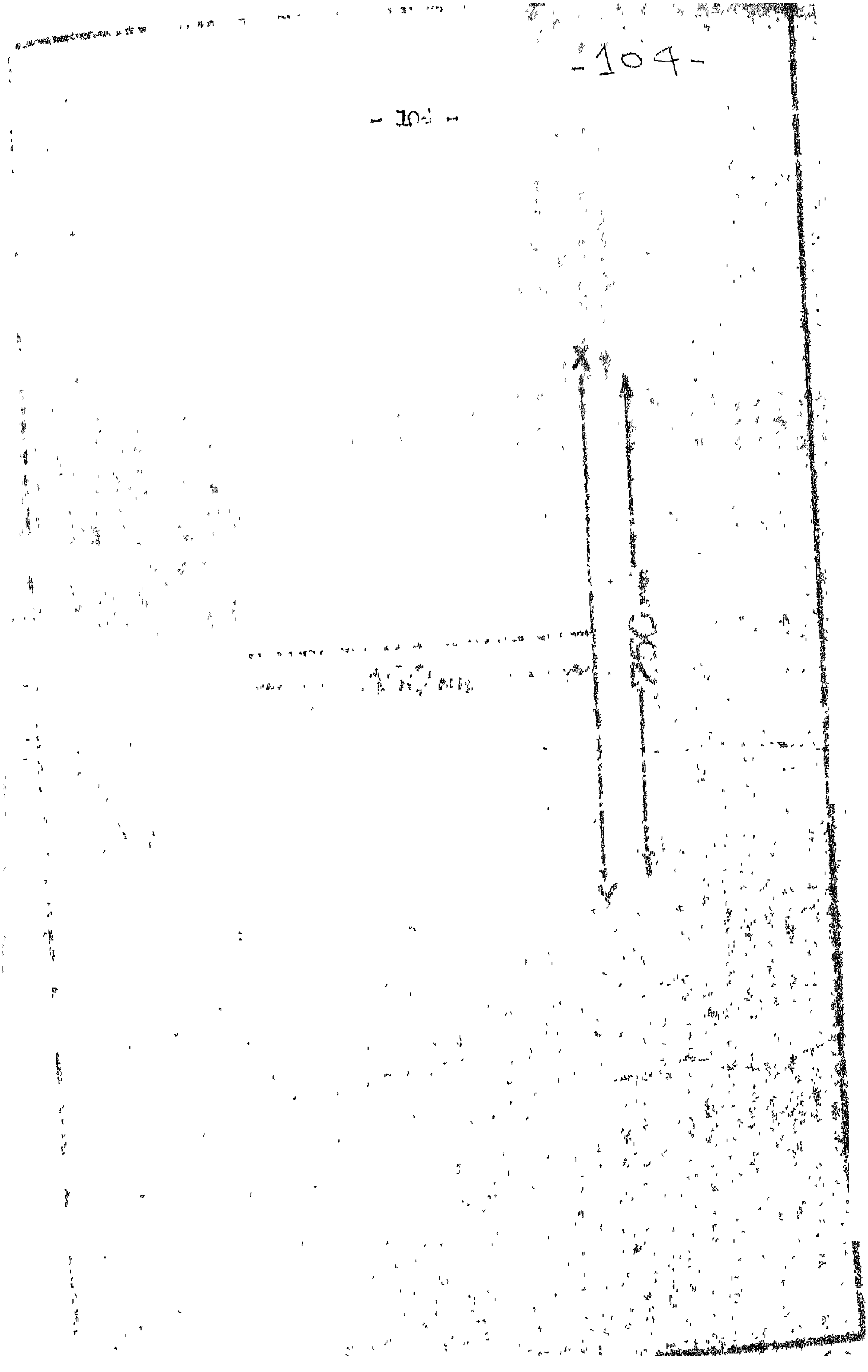
4. Avoid loose connections and joints of the cable during wirin

QUESTIONS FOR EVALUATION:

1. What is the distance between clip to clip to be maintained.

2. What radius of the cable for be-nding is to be maintained ?

3. How do you select the size of cutting round block ?


X
250

EXPERIMENT/PRACTICAL NO: 36

TITLE OF EXPERIMENT/PRACTICAL

Control of one lamp from two different places-Wiring on T.W.Batten (Stair case wiring).

SPECIFIC OBJECTIVES

At the end of this excercise, the learner should be able to :-

1. Mark the layout diagram on the wiring board as per the measurements.
2. Cut and fix the T.W.batten and round blocks on the wiring board as per the layout.
3. Fix the link clips as per I.S.I.specification and lay the cable pieces on the batten.
4. Fix and connect the accessories and test the circuit for correctness.

INTRODUCTORY INFORMATION AND RELATED THEORY

This type of wiring is used for the stair-case lighting i.e. the lamp can be operated from the two stairs. If a person wants to go to the First floor from the ground floor, he can operate the switch to illuminate the stair case from the ground floor itself. After reaching the first floor he can put off the lamp from the first floor itself. This is the advantage of this wiring.

The two-way switch consists of four terminals of which two of the one side is linked with a brass plate. The supply given on the linked side can be taken to the other two terminals by operating the switch.

Note: Before using a two-way switch check whether the common linked terminal is all-right. If not, link them with a conducting material such as copper wire.

EQUIPMENT AND MATERIALS

Hand Tools

1. Wooden foot rule four fold	600 MM
2. Tennon Saw	250 MM
3. Firmer chisel set of three	25,12 & 5
4. Wooden Mallet	

5. Hand Drill/Power drill Machine with bit of 6 mm	...
6. B.P.Hammer with handle	1/4 kg.
7. Pocker/Bradawal	150 MM
8. Insulated cutting pliar	150 MM
9. Insulated side cutter	150 MM
10. Insulated screw Drivers	150 ,100MM each
11. Electrician's knife	100 MM
12. MS/Brass plumb bob with thread	-

Raw Materials

1. T.W.Batten 12x12 MM, 20 x 12 MM
2. T.W.Round Block 90 MM Dia
3. CTS/TRS/PVC(AL) Cable 1/1.5 MM^2
4. Link clips 35 MM, 30 MM.
5. Wire Nails 12 MM x No.17
6. T.W.Corners and Bends 20 MM, 12MM
7. Two-way Switches 5A, 250V
8. Brass/bakelite Batten Holder 5A,250V
9. Wood screw 50, 25, 20, 12 MM
10. Electric lamp 100W, 250V.

Layout Diagram.

(See Figure.)

PROCEDURE:

1. Draw the circuit diagram.
2. Arrange tools and materials.
3. Mark the layout diagram on the wiring board as per the dimensions given.
4. Cut the batten as per the size and prepare the necessary joints of the batten as per layout and fix them on the board
5. Fix the link clips as per I.S.I.specification and lay the cable pieces over the batten tightly.

6. Cut the Round Blocks as per batten sizes.
7. Mark for accessories on Round Blocks and drill accordingly.
8. Fix the Round blocks and accessories lightly with the help of wood screws.
9. Connect the accessories as per the circuit diagram.
10. Give the supply and test the circuit.

TABULAR RECORD OF OBSERVATION :

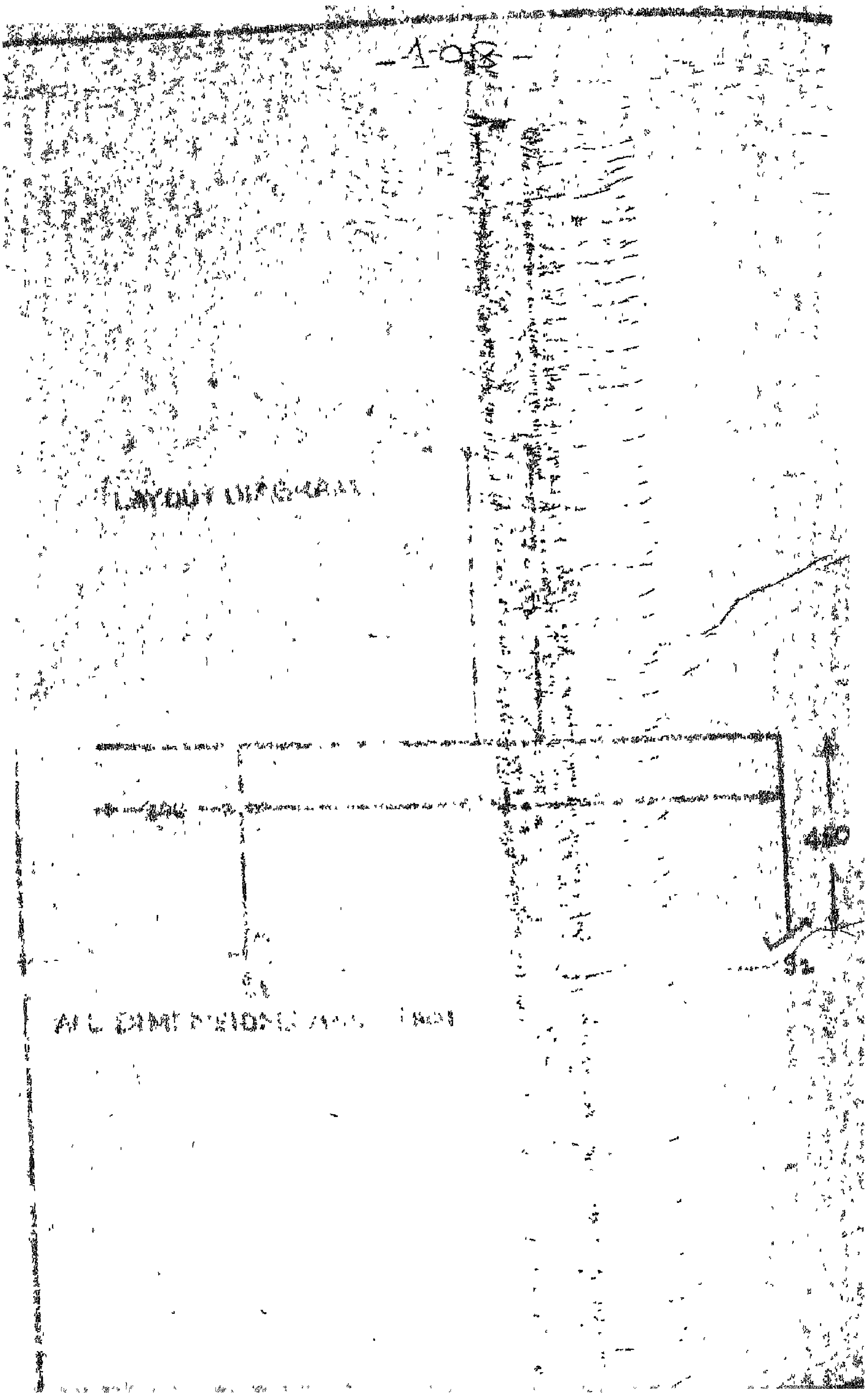
With either of the two-way switches (S_1& S_2) operation the light can be put ON or OFF as per the requirement either from the Ground Floor or from Ist floor of the building.

PRECAUTIONS :

1. The cable should be bent at a radius 6 times the overall diameter of the cable used.
2. Avoid sharp edges on the batten.
3. Keep all the eye-lids of the clips to one side of the batten.
4. Avoid loose connections and joints of the cable during wiring.

QUESTIONS FOR EVALUATION:

1. What is the radius of the cable bends used while cables are laid on the batten ?
2. Explain how the operation of two-way switches is carried out for the lamp to be ON and to be OFF?
3. Where is this type of wiring used generally ?


1-08
LAYOUT DIAGRAM
450
92
ALL DIMENSIONS ARE IN INCH

EXPERIMENT/PRACTICAL NO: 37

TITLE OF EXPERIMENT/PRACTICAL:

Control of one lamp from 3 places with intermediate switch-using T.W. batten and CTS/TRS/PVC Cables.

SPECIFIC OBJECTIVES :

At the end of this exercise the learner should be able to.

1. Mark the layout diagram on the wiring board as per the measurements.
2. Cut and fix the T.W. batten and Round blocks on the wiring board as per the layout.
3. Fix the link clips as per I.S.I. specifications and lay the cable on the batten.
4. Fix and connect the accessories and test the circuit for correctness.

INTRODUCTORY INFORMATION AND RELATED THEORY :

This type of wiring is used to control one lamp or two lamps from 3 places, generally used in hospital carridor lighting. The intermediate switch has four terminals, if the knob is operated in one direction the connection will be in one direction, and if the knob is operated in the other direction the current will flow in some other direction as per the figure in given:

(see figure)

Note : If you are not provided with an intermediate switch, you can use two, two way switches coupled in such a way to act as an intermediate switch.

EQUIPMENT AND MATERIALS :

Hand Tools : (1) Wooden foot rule four fold- 600 mm

(2) Tenon saw 250 mm

(3) Firmer chisel set of 3, 25, 12 and 6 mm.

(4) Wooden Mallet

(5) Hand drill/Power drill machine with a drill bit of 6 mm.

(6) B.P. Hammer with handle 1/4 kg.

(7) Pocker/Bradawal 150 mm.

(8) Insulated cutting pliers 150 mm

(9) Insulated side cutter. 150 mm

(10) Insulated screw driver 100 mm, 150 mm.

(11) Electricians knife 100 mm.

(12) M.S./Brass plumb bob with thread.

Raw Materials :

T.W. batten 12 x 12 mm, 20 x 12 mm

T.W. Round blocks 90 mm dia

T.W. corners and Bends 12 mm, 20 mm

Link clips 30 mm 35 mm

Wire nails 12 mm x No. 17

Two way switches 5A, 250V

Intermediate switch 5A, 250V

Brass/Bakelite batten Holders 5A, 250V

Wood screws 50, 25, 20, 12 mm

Electric lamps 100 W, 250 V

Layout Diagram:

(see figure)

PROCEDURE:

1. Draw the circuit diagram.
2. Arrange tools and materials.
3. Mark the layout diagram on the wiring board as per dimensions given.

4. Cut the batten as per the sizes and prepare the necessary joints of the batten.
5. Fix the link clips as per ISI specifications and lay the cable over the batten tightly.
6. Cut the Round blocks as per the batten sizes.
7. Mark for the accessories on Round blocks and drill holes accordingly.
8. Fix the round blocks and accessories tightly with the help of wood screws.
9. Connect the accessories as per the circuit diagram.
10. Give the supply and test the circuit.

TABULAR RECORD OF OBSERVATION:

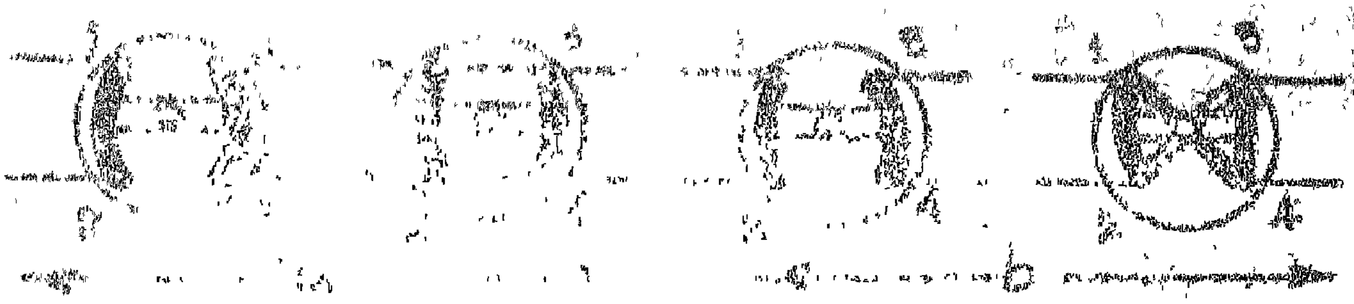
The lamp could be controlled by operating any of the 3 switches.

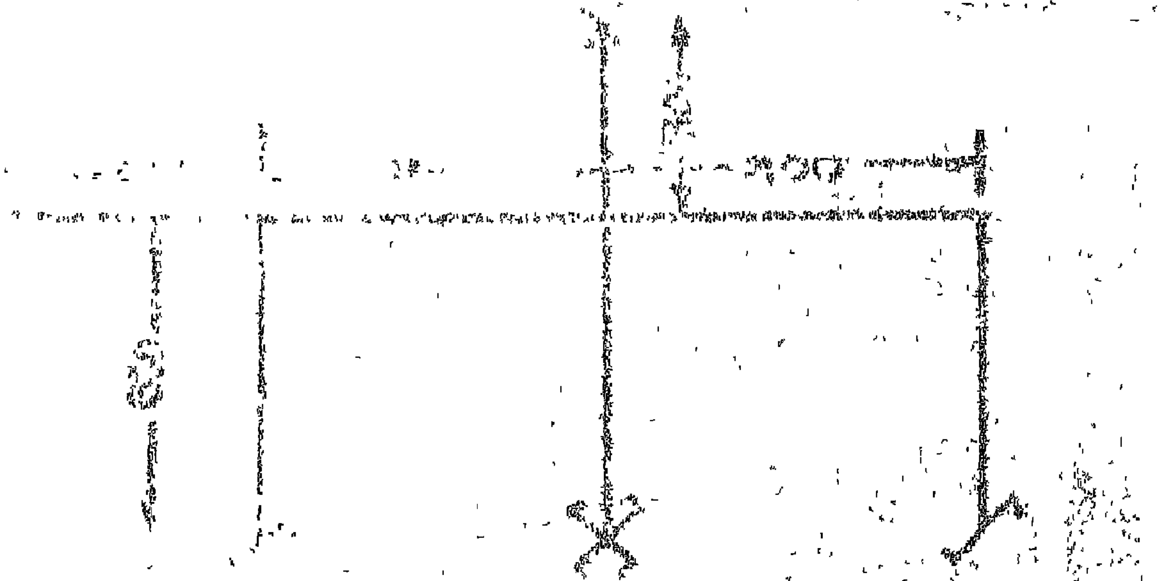
PRECAUTIONS:

1. The cable should be bent at a radius of 6 times the overall diameter of the cable used.
2. Avoid sharp edges on the batten.
3. Keep all the eye lids of the clips to one side of the batten.
4. Avoid loose connections and joints.
5. Cable ends should not be projected over the terminals of accessories.

QUESTION FOR EVALUATIONS:

1. What is the radius of the cable bend ?
2. What are the operating positions of intermediate switch?
3. Give an example of using this type of wiring ?





ALL DIMENSIONS IN mm.

EXPERIMENT/PRACTICAL NO. 33

TITLE OF THE EXPERIMENT/PRACTICAL:

Control of two lamps from three different places using T.W. Batten and CTS/PVC/TRS cable.

SPECIFIC [illegible]

At the [illegible] the learner should be able to:

1. Mark the lay [illegible] on the wiring board as per the dimensions [illegible].
2. Cut and fix [illegible] batten and Round blocks on the wiring board as per the lay out marked after fixing link clips on the batten.
3. Cut the cable into pieces and lay them on batten tightly with the help of link clips.
4. I[illegible] the accessories and test the circuit.

[illegible] RELATED THEORY:

In this [illegible] intermediate or polarity switch has not [illegible] two way switches coupled in such [illegible] switch, can be used.

EQUIPMENT AND MATERIALS.

Hand Tools:

1.	Wooden Foot Rule four fold	600 mm
2.	Tennon Saw	250 MM
3.	Firmer chisels set of three	25,12,6 MM
4.	Wooden Mallet	-
5.	Hand/Power Drill machine with 6 MM Drill Bit	
6.	B.P. Hammer	1/4 kg.
7.	Pocket [illegible]	150 MM

8. Insulated cutting pliers 150 MM
9. Insulated side cutting pliers 150 MM
10. Insulated screw drivers 150, 100 MM each.
11. Electricians Knife 100 MM
12. M.S./Brass plumb-bob with thread.

Raw Materials:

1. T.W. Batten 12 x 12, 20x12
2. T.W. Round Blocks 90 MM dia

3. Link clips 30 mm, 35 mm
4. Wire nails 12 MMx No.17
5. Two way switches 5A, 250V
6. Batten Holder 5A, 250
7. Wood Screws 50, 25, 20, 12 MM
8. Electric lamps 100W, 250V
9. CTS/PVC/FRS/ code (Al) 1/1.5 mm

Layout Diagram:

(see figure)

PROCEDURE:

1. Draw the circuit diagram.
2. Arrange tools and materials.
3. Mark the lay out diagram on the wiring board as per the dimensions given.
4. Cut the batten as the sizes and prepare the necessary joints of the batten.
5. Fix the link clips on batten as per ISI specifications and lay the cable on the batten tightly.
6. Cut and drill the round blocks as per the batten size and accessories positions marked.
7. Fix the round blocks and accessories in positions tightly in the screws.

8. Connect the accessories as per the circuit diagram.
9. Give supply and test for correctness.

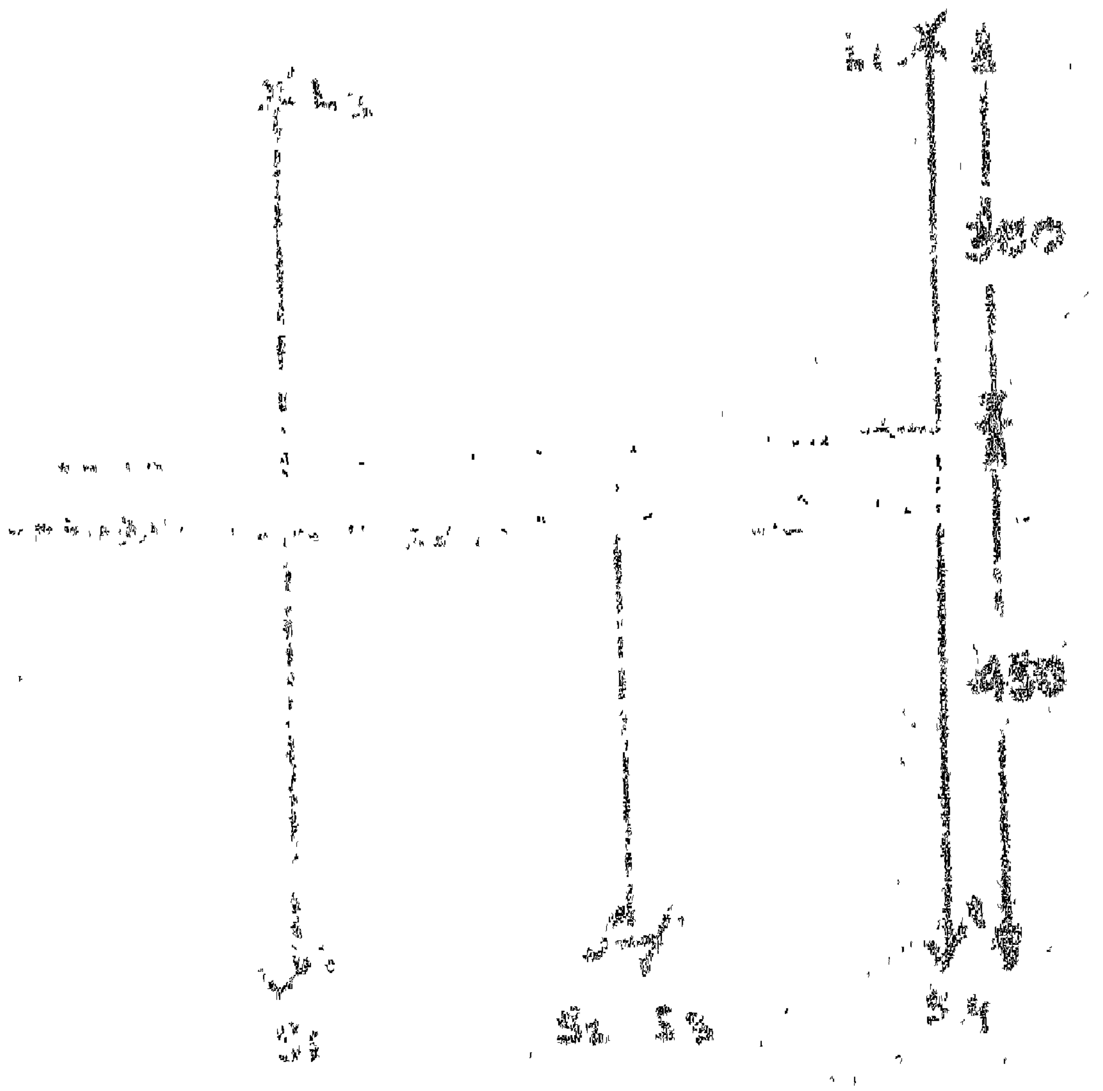
PRECAUTIONS:

The cable should be bent at a radius equal to six times the overall diameter of the cable used.

1. Avoid sharp edges on the batten.
2. Keep all the eye lids of the clips to one side of the batten.
3. Avoid loose connections and joints while using cable.
4. Cable ends should not be projected over the terminal tops of the switches.

QUESTIONS FOR EVALUATIONS:

1. What is the difference in the connection of an intermediate switch and two, two-way switches using in the circuit.
2. Where this type of wiring is mostly used and Why ?



ALL DIMENSIONS ARE IN MM

EXPERIMENT/PRACTICAL NO: 39

TITLE OF EXPERIMENT/PRACTICAL:

Godown wiring for 3 points on T.W.batten using PVC/CTS/TRS cable.

SPECIFIC OBJECTIVES:

At the end of this exercise the learner should be able to:

1. Mark the layout diagram on the wiring board as per the measurement.
2. Cut and fix the T-W. batten and Round blocks on the wiring board as per the layout.
3. Fix the link clips as per ISI specifications and lay the cable on the batten.
4. Fix and connect the accessories and test the circuit for correctness.

INTRODUCTORY INFORMATION AND RELATED THEORY:

This type of wiring is always used in godown which consist of a number of rooms in a line with only one entrance, so when the door is opened and the switch is operated the lamp inside the Ist room will be on. If required to go to the next room the door is opened and by operating the switch placed by the side of the door the lamp in the second room will be on and the lamp in Ist room will be off and so. Always the knobs of all the 3 switches will be in the upward position.

EQUIPMENT AND MATERIALS:

Hand Tools:

1.	Woolen foot rule four fold	600 mm
2.	Tennon saw	250 mm

3. Firmer chisel set of three, 25, 12 and 6 mm
4. Wooden mallet.
5. Hand drill/Power drill machine with drill bit of 6 mm.
6. B.P.Hammer with handle 1/4 Kg.
7. Pocker/Bradawl 150 mm.
8. Insulated cutting pliers 150 mm.
9. Insulated side cutter 150 mm
10. Insulated screw driver 150, 100 mm
11. Electricians knife 100 mm.
12. M.S./Brass Plumb-bob with thread.

Raw Materials:

T.W. Batten 12 x 12 mm, 12 x 20 mm
T.W. round block 90 mm dia
CTS/TRS/PVC 'AL' cable 1/1.5 mm^2
Link clips 35 mm, 30 mm
Wire nails 12 mm x No.17
T.W. corners and bends 20 mm, 12 mm
S.P.T. switches 250 V, 5A
Brass/Bakelite batten Holder 5A, [illegible] 250V
Wood screws 50, 25, 20, 12 mm
Electric lamps 100W, 250 V

Circuit Diagram:

(see figure)

PROCEDURE:

1. Draw the circuit diagram.
2. Arrange the tools and materials.
3. Mark the layout diagram on the wiring board as per the dimensions given.

4. Cut the batten as per the sizes and prepare the necessary joints of the batten as per the layout and fix them on the board.
5. Fix the link clips as per ISI specifications and lay the cable over the batten tightly.
6. Cut the round blocks as per the batten sizes.
7. Mark for accessories on Round blocks and drill holes accordingly.
8. Fix the round blocks and accessories tightly with the help of wood screws.
9. Connect the accessories as per the circuit diagram.
10. Give the supply and test the circuit.

TABULAR RECORD OF OBSERVATION:

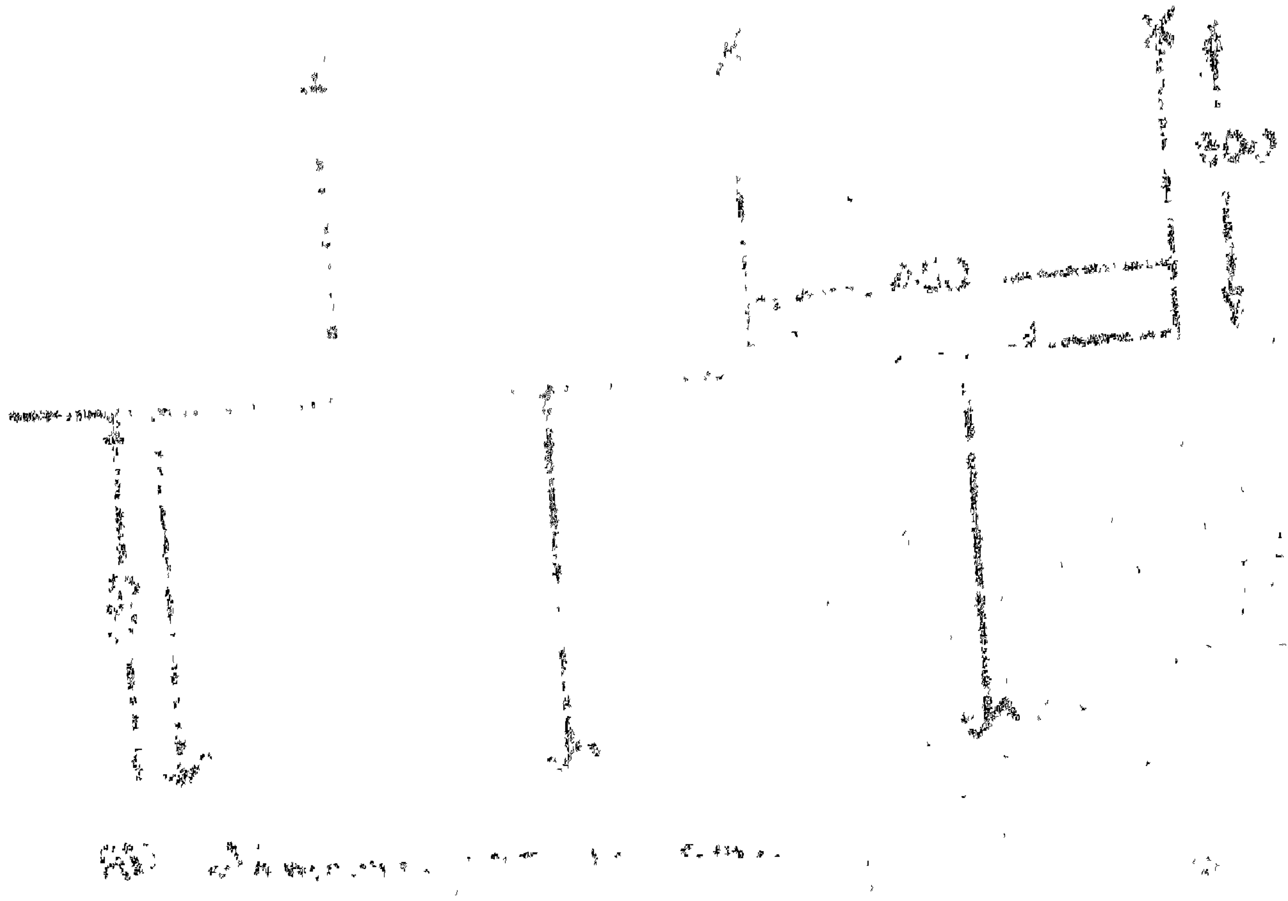
1. Always the knobs of all the 3 switches are kept in the upward direction.
2. When the 1st switch is operated 1st lamp is on.
3. When the 2nd switch is operated 1st lamp is off and 2nd lamp is on.
4. When the 3rd switch is operated 2nd lamp is off and 3rd lamp is on.
5. In reverse process while returning back the same procedure is followed.

PRECAUTIONS:

1. The cable should be bent at a radius 5 times the overall diameter of the cable used.
2. Avoid sharp edges of the batten.
3. Keep all the eyelids of the link clips to one side of the batten.
4. The wires should be straight on the batten.
5. Avoid loose connections and joints.

QUESTIONS FOR EVALUATION:

1. How many 2-way switches are used in 3 points godown wiring.?
2. What should be the distance between clip to clip to Maintain wall wiring ?
3. What is the size of the wire used for this wiring ?



EXPERIMENT/PRACTICAL NO: 40

TITLE OF EXPERIMENT/PRACTICAL:

Multi-stair case wiring for a three Storey Building on T.W. batten with CTS/TRS/PVC cable.

SPECIFIC OBJECTIVES:

At the end of this exercise, the learner should be able to:

1. Mark the lay out diagram on the wiring board as per the dimension given.
2. Cut and fix the batten and Round Blocks on the wiring board as per lay out.
3. Fix the link clips as per ISI specification and lay the cable on the batten.
4. Fix and connect the accessories and test the circuit for its correctness.

INTRODUCTORY INFORMATION AND RALATED THEORY:

This type of wiring is most generally used for the stair-case lighting of multi-storey flats/buildings as the lamps can be operated from the three stairs as is done in the case of one lamp controlled from two stair.

In this wiring the lamps are controlled by the combination of two-way and intermediate switches simultaneously.

Note:- Before using the two-way and intermediate switches check that the commonly linked terminals and the operating positions of the switches are all right. If necessary, the links to be provided by means of coper wire.

EQUIPMENT AND MATERIALS:

Hand Tools:

1.	Wooden Feet rule Four Fold	600 MM
2.	Tennon Saw	250 MM
3.	Firmer chisels set of three	25, 12, 6 MM
4.	Wooden Mallet	
5.	Hand/Power Drill Machine with 6 MM Drill Bit-	
6.	B.P. Hammer with Handle	1/4 kg.
7.	Pocker/Bradawl	150 MM
8.	Insulated cutting pliers	150 MM
9.	Insulated side cutter	150 MM
10.	Insulated screw Drivers	150, 100 MM each
11.	Electricians knife	100 MM
12.	M.S/Brass Plumb-bob with thread	----

Raw Materials:

1. T.W. Batten 20 x 12 MM 12 x 12 MM
2. T.W. Round blocks 90 MM dia.
3. T.W. corner and Bends 20 MM, 12 MM
4. CTS/TRS/PVC Al. Cable 1/1.5 mm^2
5. Link clips 35, 30 MM
6. Wire nails 12 MM x No.17
7. Two-way switches and Intermediate switches 5A, 250 V
8. Batten Holder 5A, 250V
9. Wood Screws 50, 25, 20, 12MM
10. Electric lamps 100 W, 250 V

Layout Diagram:

(see fig.)

PROCEDURE

1. Draw the circuit diagram.
2. Arrange tools and materials.

3. Mark the layout diagram on the wiring board as per the dimensions given.
4. Cut the battens as per the sizes and prepare the necessary joints of the batten as per the layout and fix them on the board.
5. Fix link clips as per I.S.I. specifications and lay the cable over the batten tightly.
6. Cut the Round Blocks as per the batten sizes layout positions.
7. Mark for accessories on Round Blocks and drill holes accordingly.
8. Fix the Round Blocks and accessories tightly with the wood screws.
9. Connect the accessories as per the circuit diagram.
10. Give the supply and test the circuit.

TABULAR RECORD OF OBSERVATION:

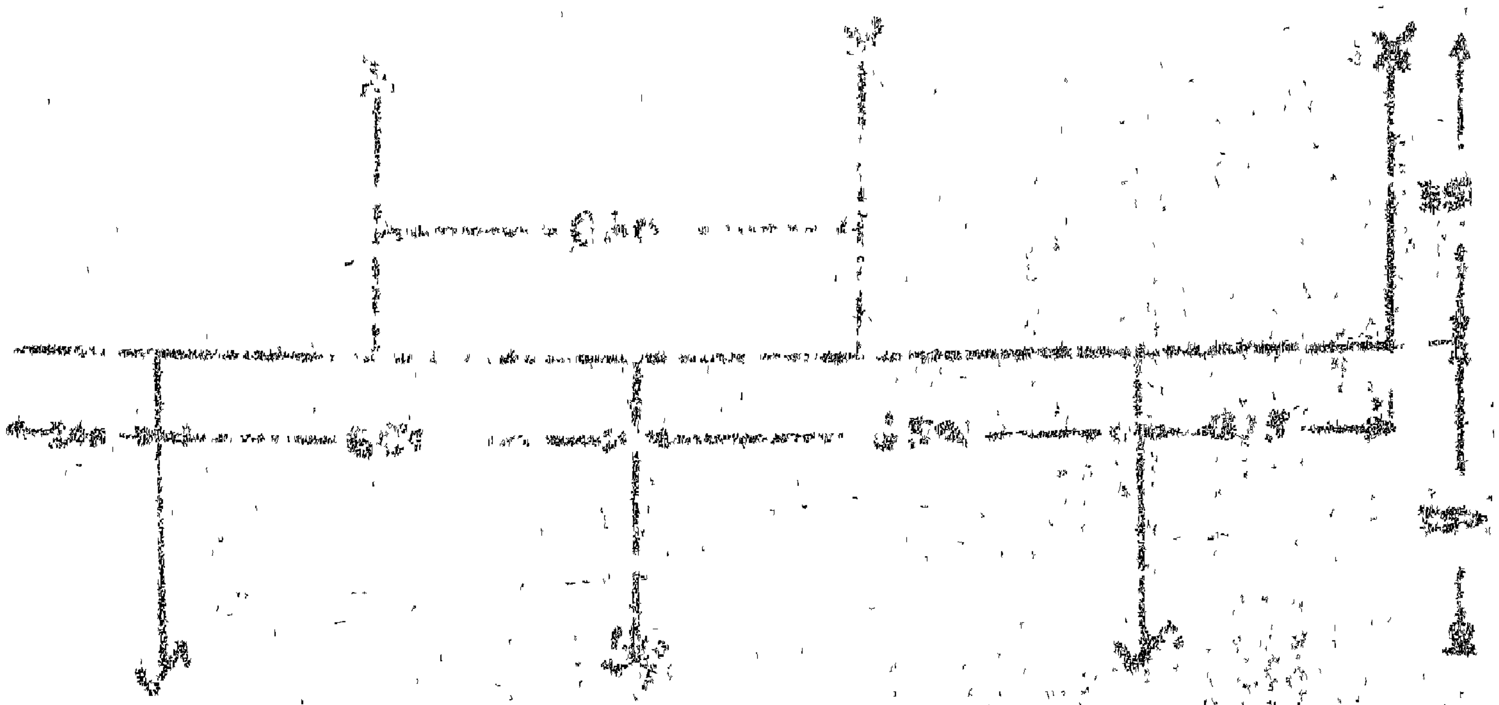
This type of wiring is mostly used for illuminating the stair cases in multi-storey building/flats.

PRECAUTIONS:

1. The cable should be bent at a radius six times of the overall diameter of the cable used.
2. Avoid sharp edges of the batten.
3. Keep all the eye-lids of the clips to one side of the batten.
4. Avoid loose connections and joints.

QUESTIONS FOR EVALUATION:

1. What are the types of switches used in Multistair case wiring ?
2. How the lights in the stair cases are desired ?



All dimensions are in mm

EXPERIMENT/PRACTICAL NO: 41

TITLE OF EXPERIMENT/PRACTICAL:

Control of one lamp from two places and to provide a three pin-plug and a main switch with fuse cut-outs in a lighting circuit.

SPECIFIC OBJECTIVES

At the end of this exercise, the learner should be able to:

1. Mark the lay out diagram correctly on the wiring board as per the dimensions given.
2. Cut and fix the T.W.Battens and boards and blocks as per the lay out marked.
3. Fix the clips as per ISI specifications and lay the cable.
4. Mark the positions of accessories on the boards and blocks and fix them in positions.
5. Connect the accessories as per the circuit diagram and test the circuit.
6. Draw the Earth wire and connect to Iron Clad Double Pole switch and the earth terminal of 3 Pin socket.

INTRODUCTORY INFORMATION AND RELATED THEORY.

This exercise is to be carried out in similar manner as the wiring for one lamp controlled from two places (staircase wiring). In addition, a three pin socket and a main switch and fuse cut outs are also to be wired with proper earthing.

The three pin socket consists of three jacks out of which two are of equal sizes and one is big. These sockets and pins are used in places where connections are to be given to portable appliances such as table fan, heater, cooker etc. which have metal bodies.

The bigger jack or socket is earthed or grounded to a good earth generally to water mains. In the plug the bigger pin at a bit longer than the other two, so as to give earth contact before the line wire is connected to the apparatus. Also when pulling out, the line side comes before the earth. So even if there is a leakage in the body of the apparatus, the leakage current goes to earth. As the earth resistance is lower than human body, it will not give a shock. Always it is better to connect all portable equipments through a three-pin plug and socket for safety.

If the body of any apparatus is connected to a good earth, when there is a leak on the body, the electrical potential of the body is brought equal to the ground potential and so a man who stands on the ground is not affected by current through the charged body of the apparatus.

EQUIPMENT AND MATERIALS :

Hand Tools :

1.	Wooden Foot Rule Four Fold	600 MM
2.	Tennon saw	250 MM
3.	Firmer chisels set of three 25, 12, 6 MM	
4.	Wooden Mallet	-
5.	B.P.Hammer with handle	1/4 kg.
6.	Hand/Power Drill Machine with 6MM drill bit	
7.	Insulated cutting pliers	150 MM
8.	Insulated side cutter	150 MM
9.	Insulated screw drivers	150,100 MM each
10.	M/S Brass plumb-bob with thread	
11.	Pocker/Bradawal	150 MM
12.	Try.Square with box.	150 MM

Raw Materials :

1. T.W.Batten 20,12 MM
2. T.W.Round blocks 90 MM dia

3. T.W. Corners and Bends 20, 12 MM
4. T.W. Board 200 x 250 MM
5. I.C.D.P. Switch 15A 250V
6. I.C. porcelain cut outs 15A 250V
7. CTS/TRS/PVC all cable 1/1.5 MM^2
8. CTS/TRS/PVC all cable 1/2.5 MM^2
9. H.D.B.C. wire No.14 SWG
10. Link clip 30, 35, 40 MM
11. Wire Nails 12 MM x No.17
12. Wood screw 50, 25, 20, 12 MM
13. Electric lamps 100W, 250V
14. 3-Pin Socket with plug 5A, 250V
15. Two way switches 5A, 250V
16. Porcelain Base tumbler switch 250V, 5A
17. Batten Holder Brass/Bakelite -
    ([illegible]) 5A, 250V
18. Pendent Holder Brass/Bakelite (for test lamp) 5A, 250V
19. Tinned copper fuse wires 5A & 15A 250V

Circuit Diagram:

(see fig.)

PROCEDURE:

1. Draw the circuit diagram.
2. Arrange tools and materials.
3. Mark the lay out diagram on the wiring board as per the dimensions given.
4. Cut the Batten and Boards and Blocks as per the layout positions and prepare the joints of the batten as required.
5. Fix the link clips as per I.S.I. specifications on the batten and fix the batten on the wiring board.

6. Lay the cable pieces as per the circuit diagram and tighten with clips fixed.
7. Mark the accessories positions on the Boards and Blocks and drill accordingly and fix them on the wiring board.
8. Fix the accessories on the boards and blocks as per the circuit diagram and connect the wire terminals to the accessories terminals tightly.
9. Draw and connect the earth wire to the Metal Bodies of the accessories and to water tap.
10. Fix the fuse wire in cut-outs and fuse links of the I.C.D.P. Switch.
11. Give supply and test the lighting circuit and plug socket circuit with test lamp.

TABULAR RECORD OF OBSERVATION:

1. Check the light point and plug socket point connecting any apliance/test lamp for its correctness.
2. Check the Earth terminal of the plug socket for its correctness i.e. for leakage and for check etc.
3. Check all the metallic bodies of the accessories for their proper earth continuity.

PRECAUTIONS:

1. Avoid sharp edges of the batten.
2. Cable should be drawn during bends at a radius equal to six times of the over all diameter of the cable used.
3. Proper earthing should be done to all the metallic parts of the accessories.
4. Put the correct size of the fuse wire in the cut outs.

QUESTIONS FOR EVALUATION:

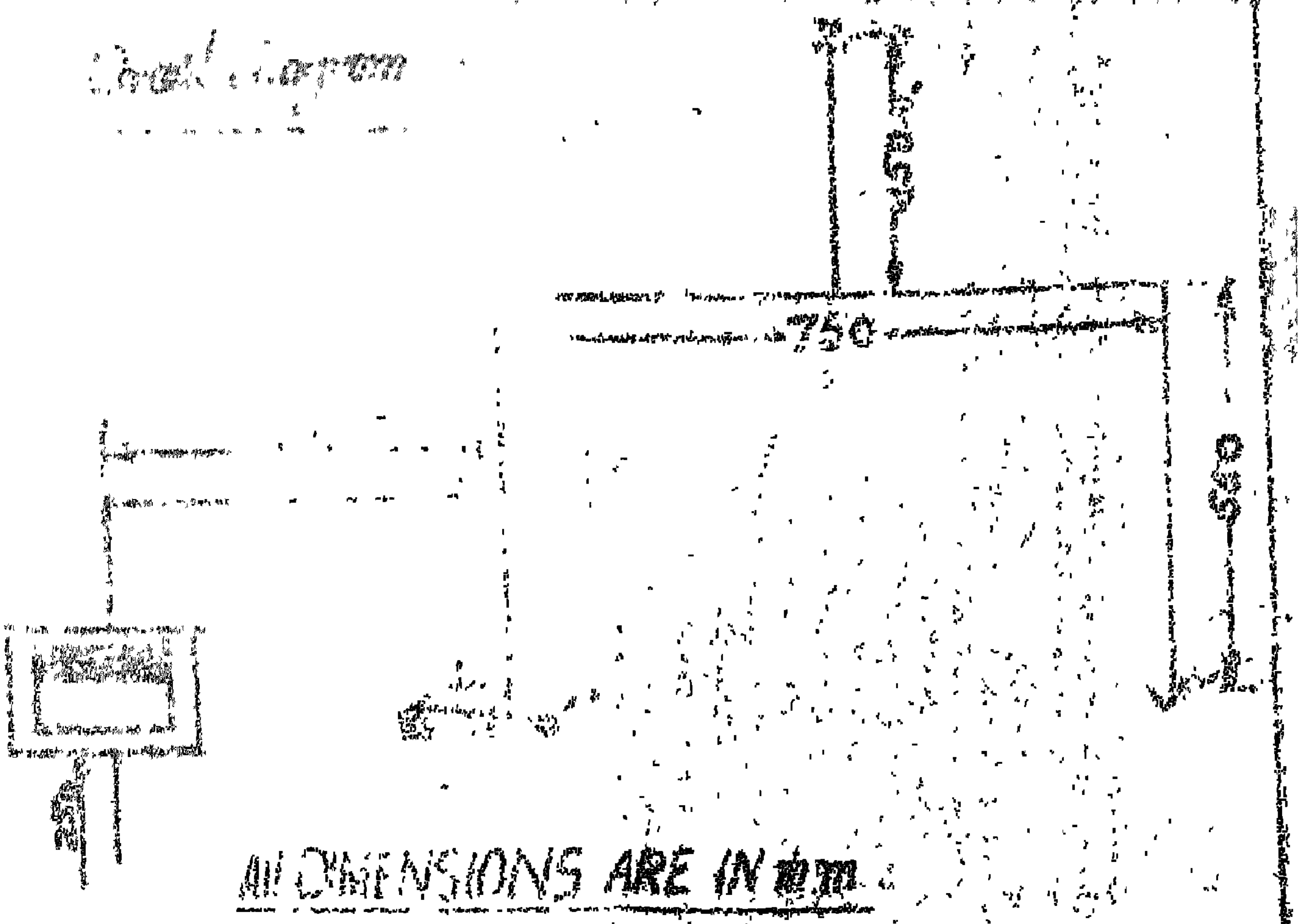
1. What is the purpose of the third terminal in the plug and socket ?

2. What is purpose of Earth wire ?

3. What is the use of providing cut-outs in the circuit ?

4. How the plug-socket circuit is to be tested with an appliance ?

Circuit diagram



EXPERIMENT/PRACTICAL NO 42.

TITLE OF EXPERIMENT/PRACTICAL:

Control of a lamp from two places and to provide a 3-Pin socket and Main switch with fuse cut-outs in a power circuit.

SPECIFIC OBJECTIVES :

At the end of this exercise, the learner should be able to :

1. Mark the lay-out diagram correctly on the wiring board as per the dimensions given.
2. Cut and fix the T.W.Boards and blocks and batten as per the lay-out marked.
3. Fix the clips as per the I.S.I. specifications and lay the cable.
4. Mark the positions of accessories on the boards and blocks and fix them in positions.
5. Connect the accessories as per the circuit diagram.
6. Draw the earthwire and connect to the I.C.D.P. Switch and earth terminal of 3 Pin socket.
7. Test the circuit by giving supply.

INTRODUCTORY INFORMATION AND RELATED THEORY:

This exercise is to be carried out in similar manner as one lamp controlled from two places(stair-case wiring) along with a three-pin 15 Amperes Power socket and cut outs and a Main switch of 15 amperes each in the circuit .
The connections of the three-pin socket 15A, cut-outs and main switch are exactly similar to that of the wiring done in of 5 Amperes appliance.

EQUIPMENT AND MATERIALS:

Hand Tools:

1. Wooden Foot Rule Four Fold 600 MM

2.	Tennon Saw	250 MM
3.	Firmer chisels set of three	25,12,6 MM
4.	Wooden Mallet	–
5.	B.P.Hammer with handle	1/2 Kg.
6.	Hand/Power Drill Machine with 6 MM Drill Bit	–
7.	Insulated cutting pliers	150 MM
8.	Insulated side cutter	150 MM
9.	Insulated screw drivers	150,100 MM each
10.	Pocker/Bradawl	150 MM
11.	Try Square with base	150 MM
12.	M.S./Brass Plumb-bob with thread	–

Raw Materials

1. T.W.Batten 20,12 MM
2. T.W.Round blocks 90 MM Dia
3. T.W.Board 250 x 300 MM
4. T.W.corners and bends 20, 12 MM
5. I.C.D.P. Switch 15 A-250V
6. I.C./Porcelain cut outs 15A, 250V
7. CTS/TRS/PVC Al cable 1/1.5 mm^2
8. CTS/TRS/PVC Al cable 1/2.5 mm^2
9. H.D.B.C. conductor No. 12 SWG
10. Link clips 30,35,40 MM
11. Wire nails 12 MM x No.17
12. Wood screws 50,25,20,12 MM
13. Electric lamps 100W, 250V.
14. 3 Pin socket with plug 15A, 250V
15. Two way switches 5A, 250V
16. Porcelain Base tumbler switch 15A-250V
17. Batten Holder 5A, 250V
18. Pendent Holder 5A, 250V
19. Tinned Copper fuse wire 15 Amp. Cap

Circuit Diagram

(see fig.)

PROCEDURE

1. Draw the circuit diagram.
2. Arrange tools and materials.
3. Mark the layout diagram on the wiring board as per the dimensions given.
4. Cut the Batten, Boards and Blocks as per layout positions marked and prepare the necessary joints in batten.
5. Fix the link clips as per I.S.I. specifications on the batten and fix the batten on the wiring board.
6. Cut and lay the cable pieces on the batten as per circuit diagram and tighten with the help of clips.
7. Mark the accessories position on the Boards and blocks and drill accordingly and fix them on the wiring board.
8. Fix the accessories on the blocks and boards as per the circuit diagram and connect the cable ends to the terminals of the accessories tightly.
9. Draw and connect the earth wire to the metallic bodies of the accessories and to the water tap.
10. Fix the fuse wire in cut-outs and fuse link of the I C.D.P. Switch.
11. Give supply and test the lighting and power plug circuits.

TABULAR RECORD OF OBSERVATION

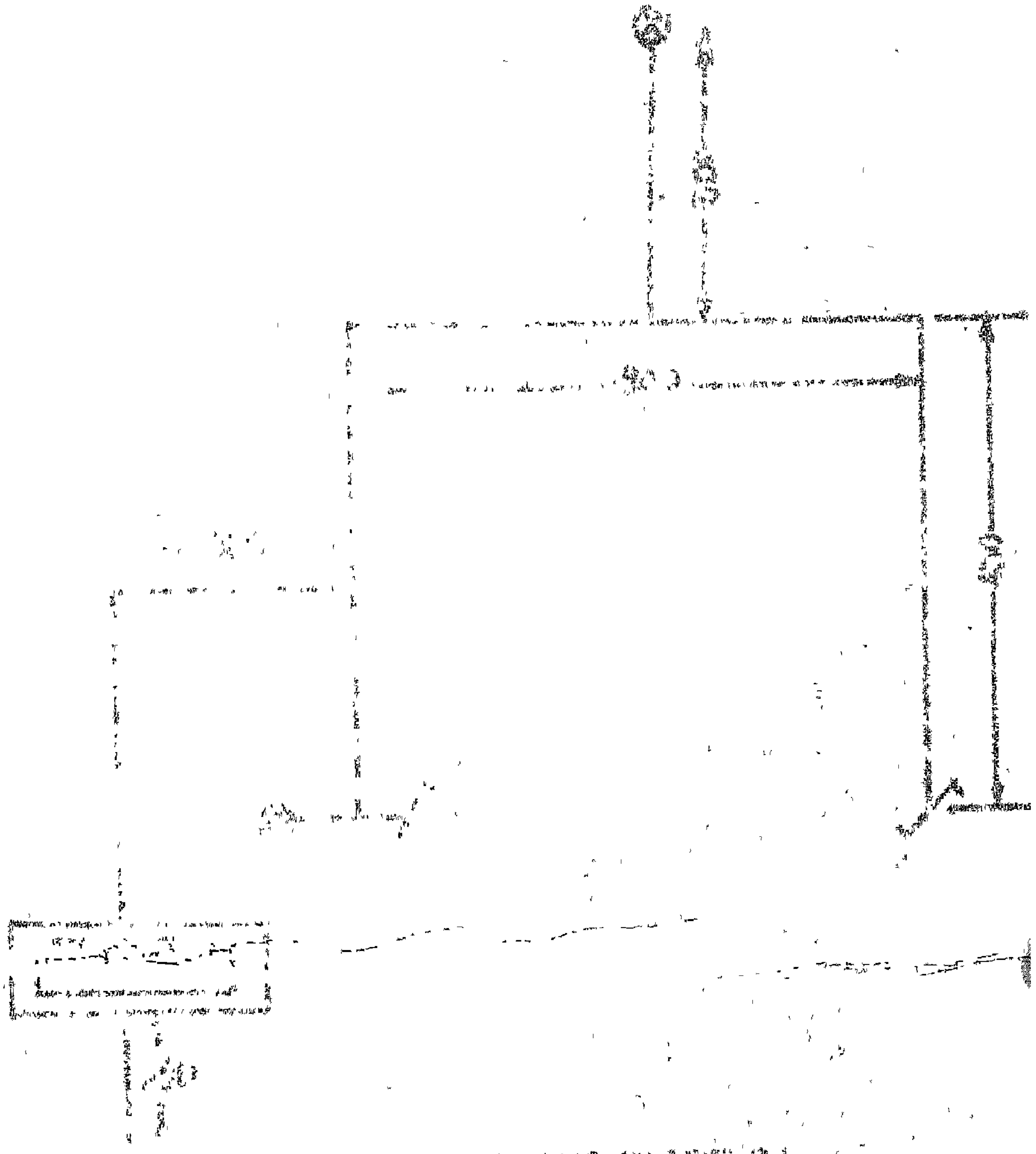
1. Test the lighting and Power plug circuits independently and collectively for their correctness with supply.
2. Test for Earth continuity of the metallic bodies of the accessories used in wiring and with water tap.
3. Put the fuse wire of the proper sizes in circuit.

PRECAUTIONS :

1. Avoid sharp edges of the batten.
2. Cable should be drawn during bends at a radius equal to six times the overall diameter of the cable used.
3. Earth connections should be done tightly.
4. Fuse wires should be connected tightly.

QUESTIONS FOR EVALUATION

1. What is the main difference in the lighting and power circuit wiring ?
2. How is the size of Earth wire to be selected ?



ALL DIMENSIONS ARE IN mm.

EXPERIMENT/PRACTICAL NO.43

TITLE OF EXPERIMENT/PRACTICAL

Practice of cutting of a metal conduit and to thread correctly to suit the conduit accessories.

SPECIFIC OBJECTIVES:

At the end of this exercise the learner should be able to:

1. Measure, mark and cut the metal conduit.
2. Select and set the conduit die set according to the size of pipe.
3. Cut the conduit pipe, and prepare threads.

INTRODUCTORY INFORMATION AND RELATED THEORY:

For electrical wiring purpose the conduit used is of a rigid steel pipe. The pipes must be cut bent and thread as required to form a path as per the dimensions given in the layout diagram. Two types of conduits are employed in electrical wiring called rigid and thin walled only rigid conduits required threading.

EQUIPMENT, TOOLS AND RAW MATERIALS:

TOOLS:

1. Hack saw frame adjustable with blade 32 TPI-300 mm.
2. Conduit die set with bits complete.
3. Pipe vice - 50 mm.
4. Oil can - 2 pint.
5. File half round - Bastered - 250 mm, 150 mm.
6. Steel rule - 300 mm.
7. Try square - 150 mm.

RAW MATERIALS:

1. Steel conduit Heavy gauge pipes 20 mm, 25 mm, as available.
2. Conduit accessories of different sizes like 'T' Junction box - bend - elbow - couplings etc.
3. Cotton waste.

LAY OUT DIAGRAM:

See and follow the attached sheet.

PROCEDURE:

1. Arrange all the tools and materials.

Cutting operation:

2. Fix the conduit/pipe in pipe vice rigidly keeping 200 mm length away from the vice.

3. Mark the place of cutting over the pipe.

4. Cut with Hack Saw on the marking slowly such that a cut formation is visible.

5. Move the Hacksaw to and fro directions until the pipe is cut. When the Hack Saw blade reaches the second wall, hold the piece with left hand.

6. Remove the burrs with half round file.

Threading Operation:

7. Select and set the die set according to the size of the pipe.

8. Move the die set slowly, such that it will enter into pipe outer diameter.

9. Rotate the die set slowly clockwise and anticlockwise directions.

10. Use oil frequently on cutting edge.

11. Repeat the operation by tighting the die bit positions suitable to accessories sizes.

TABULAR RECORD OF OBSERVATION:

The threaded conduit fitted in the accessories easily.

PRECAUTIONS:

1. Never clean the burrs by hand.
2. Keep the hacksaw blade teeth away from you while cutting.
3. Don't apply excessive pressure while cutting and threading.
4. Use oil frequently.
5. Don't hammer for fixing accessories.

6. Use proper tools for proper operations.

7. Use cotton waste over the pipe while fixing to pipe vice.

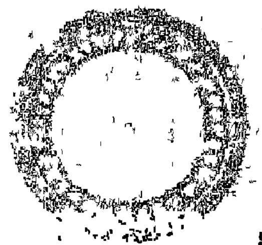
8. Never try to blow off chips.

QUESTIONS FOR EVALUATION:

1. How do you fix the conduit in the vice?

2. Why the burrs are to be removed before threading?

3. How much minimum length should be kept out in vice for threading?



[illegible]
Cornish [illegible]

[illegible] Cutting steel
[illegible]

EXPERIMENT/PRACTICAL NO.41

TITLE OF EXPERIMENT/PRACTICAL:

To prepare a conduit square using conduit accessories.

SPECIFIC OBJECTIVES

At the end of this exercise, the learner should be able to:

1. Measure, mark and cut the conduit pipe into required pieces as per the dimensions given.
2. Prepare the conduit pipe pieces for cutting threads.
3. Select the required conduit accessories for the frame marking.
4. Cut the threads over the conduit pipe ends to the required length suitable for accessories fixing.
5. Assemble the conduit frame as per diagram given.

INTRODUCTORY INFORMATION AND RELATED THEORY:

This exercise helps the learner to identify different types of conduit accessories used for various purposes and also helps the learner to fix the conduit accessories in proper according to procedure. It also develops the skill of fixing of accessories with a shorter length of pipes.

EQUIPMENT,HAND TOOLS AND RAW MATERIALS:

HANDTOOLS

1. Conduit Die set of suitable size with bits complete.
2. Pipe vice of suitable size with bench (for the vice) -- 50 mm
3. Hack-saw frame adjustable - 300 mm
4. Steel foot fule two fold - 600 mm
5. Try square with box - 150 mm
6. Adjustable spanner - 175 mm
7. Pipe wrench adjustable - 50 mm
8. Oil cane 2 pint
9. File Half Round - 250 mm, 150 mm
10. Screw Driver insulated - 200 mm

RAW MATERIALS

1. Steel conduit Heavy gauge pipe-as available sizes 20,25,30,35,50 mm
2. Conduit accessories like Tee, junction Box, Bend Elbow, Coupling,Check-nut etc.
3. Cotton Waste.
4. Hack Blade 300x12 mm x 24 TPI.

LAYOUT DIAGRAM

(See fig.)

PROCEDURE

1. Take the given conduit pipe and measure.
and mark the required lengths for cutting.
2. Arrange all tools and accessories.
3. Fix the conduit pipe piece in the pipe vice and remove the burs inside and outside of the edges.
4. Set the die bits properly in the die set.
5. Insert the pipe and into the Die-set and set the die set, for threading, firmly.
6. Put the threads of required lengths suitable to the conduit accessories selected using oil when necessary.
7. Check the thread portion with accessories, for the correct fitness.
8. Assemble the accessories and pipe piece as per the layout diagram tightly.
9. Check for the squareness with the try square.

TABULAR RECORD OF OBSERVATION

1. Check all the diagonal/measurements/of the frame and these should be all same.

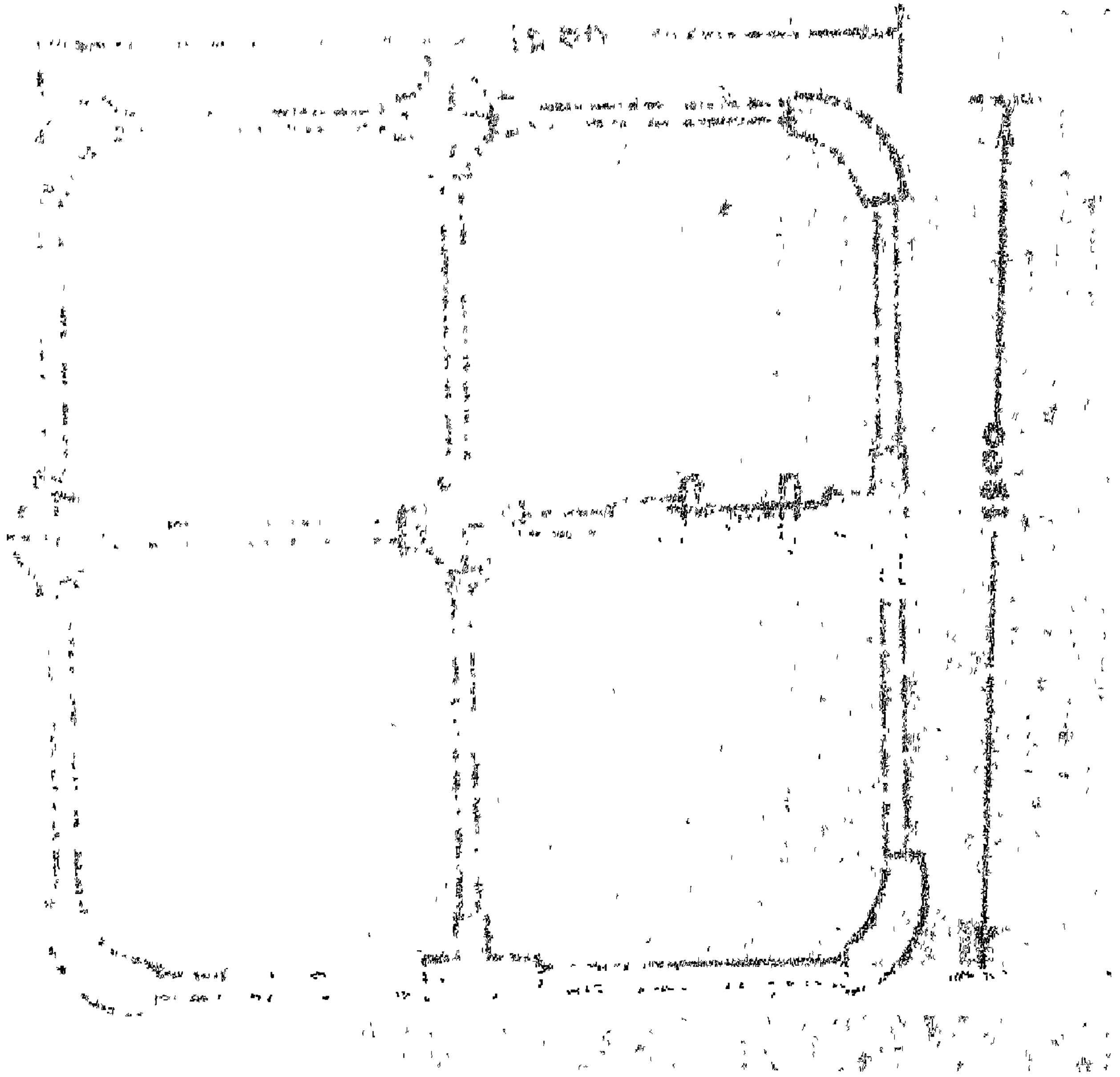
PRECAUTIONS

1. Use proper tool for proper operation
2. Set the die set for its correctness.
3. Use oil frequently.
4. Do not apply excessive pressure while cutting and threading.
5. Do not hammer for fixing accessories.

QUESTIONS FOR EVALUATION

1. Why the burrs are to be removed before starting the threading operation ?
2. How do you meaure the diagnol carry out the measurements of the frame ?
3. How do you check squareness ?

[illegible]



[illegible]

EXPERIMENT/PRACTICAL NO 45

TITLE OF EXPERIMENT/PRACTICAL

Practice of using earth wire and earth clips on metal conduits for lighting and power circuits.

SPECIFIC OBJECTIVES

At the end of this excercise the learner should be able to

1. Select thecorrect size of the earth wire and earth clips,
2. Choose the correct place for fixing the earth clips,
3. Fix the earth wire both for lighting and power circuits.

INTRODUCTORY INFORMATION AND RELATED THEORY

If a human being comes into contact with a charged frame or metallic parts, owing to any fault or leakage, there is a danger of shock which may be fatal. For protection against such danger. The frames, bodies of machines and metal conduits are earthed i.e. to attain zero potential. This excercise helps the learner to practice the correct method of providing earth on metal conduits both in lighting circuits and power circuits.

EQUIPMENT AND MATERIALS:

Hand Tools

1. Insulated cutting pliers- 150 mm.
2. Screw driver; insulated - 150 mm.
3. Side cutter insulated - 150 mm.
4. Half round file rough - 200 mm

Raw Materials

1. Conduit pipe heavy gauge of any size available.
2. Copper wire 10 and 14 SWG.
3. Earth clips copper of suitable sizes to the pipes.
4. Bolt and nuts 3 mm x 10 mm.
5. Cotton waste.

LAY OUT DIAGRAM

(See diagram)

Note: Two separate earth copper wires on both sides of conduit are placed with earth clips for power wiring.

PROCEDURE:

1. Collect all the materials and tools.
2. Mark on conduit pipes the position of fixing earth clips.
3. Remove the paint on the pipe where the position is marked either with file or sand paper.
4. Cut the required length of copper/earth wire according to layout.

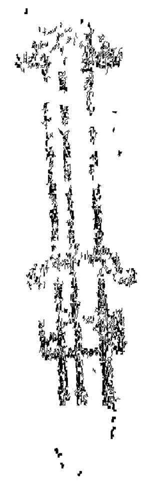
5. Place the copper wire after straightening with cotton waste parallel to the conduit.
6. Remove the bolt and nut of earth clips.
7. Fix the earth clip on the place where the paint is removed.
8. Tighten the bolt and nut firmly such that the copper wire holds to the pipe.
9. In case of running earth wires to different directions make a proper joint of the earth wire.
10. Repeat the same procedure for power circuit but with two earth wires placed parallel to conduit pipes at both edges.

PRECAUTIONS

1. Avoid unnecessary joints in earth wires.
2. The wires should be straight.
3. Remove the paint only to seat the earth clip.
4. Use proper tools for proper operations.

QUESTIONS FOR EVALUATION

1. Why earth wires are used on conduit pipes ?
2. Why the conduit pipes should be cleaned before earth clips.
3. What is the size of earth wire to be used for power circuit ?



NOTE: Two [illegible] [illegible] copper wires [illegible]
[illegible] sides [illegible] [illegible] and placed with
[illegible] [illegible] for [illegible] [illegible]

Raw Materials

1. PVC heavy gauge pipe of required sizes, 20,25, 30 mm.
2. PVC accessories like boxes, bends and tees.
3. PVC saddles of required sizes.
4. PVC al, cable 1/1.5 mm^2 and 1/2.4 mm^2
5. 'T' wooden batten supports 25 mm x 12 mm of required lengths.
6. T.W. Boards and round blocks of sizes required.
7. Wood screws of various sizes as required.
8. Single way and two-way switches as required.
9. Two-pin and three-pin sockets with plugs 5A-250 and 15A-250V as required.
10. Lamp holder batten/Pendent/Slant/5A-250V as reqd.
11. F.L.fittings 40,250/20W,250V 1.2^m/0.6m as reqd., complete with tubes.

12 Electric lamps as required.

13 I.C. D.P. main switch 30A/15A, 250V.

14. I.C./Porcelain cut outs 250V. 5/15A as required.

15 Distribution Board 6 way/12 way 15A/250V as required.

16. Bare copper conductor 14 SWG as reqd. for earthing.

17. PVC twin core copper cable 7/20 for service line as required.

18. G.I./steel wire 18 SWG as reqd as supporting conductor for service line.

19. Link clips as required.

20 Rawl plug and filling compound as required.

21. Water tight fittings as required.

22. Ceiling rose 2 plate/3 plate 250, 5A, as required.

23. Steel/copper wire 20 SWG as fish wire.

Layout Diagram:

See attached sheet.

PROCEDURE:

1 Mark the lay-out diagram given in the buildings.

2. Mark the wooden Batten supporters positions and drill with rawl tool holder and fix batten pieces.
3. Cut the PVC pipe and fix alongwith PVC boxes etc. as per lay-out marked.
4. Cut the T.W. Round blocks/Boards and fix them in position.
5. Draw the cables through pipes with the help of fish wire as per the circuit diagram.
6. Fix distribution boards, main switch, cutouts and other accessories in positions.
7. Draw the earth wire through pipes along with other cables alredy drawn wherever needed (i.e. for 3 pinsockets, D.B.s and main switch etc.)

EXPERIMENT/PRACTICAL NO: 46

TITLE OF EXPERIMENT/PRACTICAL

Wiring of a Domestic Installation having two room in PVC conduit (Surface wiring).

SPECIFIC OBJECTIVES

At the end of this excercise, the learner should be able to :

1. Mark the layout diagram in the building as per the requiremen
2. Cut the PVC conduit pipe pieces according to layout diagram and fit them in correct positions,
3. Draw the cables through the pipe lines,
4. Mark the positions of boards and accessories and fit them in positions as per the circuit diagram ,
5. Connect the accessories and test the circuit.

INTRODUCTORY INFORMATION AND RELATED THEORY

After acquising the various skills of the different wiring diagrams for different types of accessories and appliances, the learner should be able to group them all together in any compact building as per the needs of the consumer and do the systematic wirin for safer operation.

EQUIPMENT AND MATERIALS

Hand Tools

1.	Wooden Foot rule four fold.	600 mm.
2.	Tennon saw	250 mm.
3.	Hacksaw frame with blade (Adj.)	300 mm.
4.	Firmer chisels set of three	25,12, 6mm
5.	Wooden Mallet.	
6.	B.P.Hammers	1/4 kg.,1/2 kg.
7.	Insulated side cutter	150 mm.
8.	Insulated cutting pliers	200 mm.
9.	Insulated screw drivers	200,150,100 mm.
10.	Electrician's knife.	100 m.
11.	Plumb-bob with thread	
12.	Try square with box.	150 mm.
13.	Bamboo-ladder	3.6 metre
14.	Rawl tool holder with bits	Reqd. sizes.
15.	Hand/power drill m/c with drill bits.	Reqd. sizes.
16.	Pocker/bradawal.	150 mm.
17.	File wood rasp half round.	250 mm.
18.	File flat bastard.	250 mm.
19.	Energy meter 1-phase/3 phase-5/30 amperes	as required.
20.	Megger 500V.	

EXPERIMENT/PRACTICAL NO: 47

TITLE OF EXPERIMENT/PRACTICAL

Domestic installation wiring for a two room house in metal conduit (concealed wiring).

SPECIFIC OBJECTIVES:

The end of this excercise the trainees should be able to :

1. Mark the channels in the wall as per the requirement.
2. Cut and thread conduit pipes according to layout and fit them in the channels.
3. Draw the cables through the pipes with the help of fish wires.
4. Mark the positions of boards, blocks and inspection points.
5. Mark the positions of accessories on the boards/blocks and fit them according to diagrams.
6. Run the earth wires and fit them in proper positions.
7. Connect the accessories and test the circuit.

INTRODUCTORY INFORMATION AND RELATED THEORY

Surface wiring is now a days replaced with concealed wiring. After acquiring the various skills of domestic wiring of different systems, the learner should be able to group them together in any compact building under construction where concealed wiring being done, so that the learner can observe the techniques involved in this type of wiring.

EQUIPMENT AND MATERIALS:

Hand Tools:

1. Conduit die set with bits.
2. Pipe vice-- 50 mm.
3. Pipe wrench - 300 mm.
4. Adjustable spanner -- 175 mm.
5. Wooden footrule four fold 600 mm.
6. Tennon saw 250 mm.
7. Hacksaw frame adjustable with blade.
8. Firmer chisel set of three, 25 ,12, 6 mm.
9. Wooden mallet.

10 B.P.Hammers 1/4 kg. and 1 kg.

11. Insulated cutting pliers 200 mm.

12. Insulated side cutter 150 mm.

13. Insulated screw drivers 200, 150, 100 mm.

14. Cold chisel 25 x 200 ,, mm.

15. Electricians knife 100 mm.

16. Plumb-bob with thread.

17. Hand/Power drill m/c with drill bits.

18. Pocker/brodawal 150 mm.

19. File wood raspe half round 250 mm.

20. File flat bastard 250 mm.

21. File Haf round rough 150 mm.

22. Energy meter 10/30/5/30 amps.

23, Megger 500V.

24. Rawl tools and bits No.10 and 20.

Raw Materials;

1. Conduit metal pipe heavy guage as required, 20, 25, 30

2. Conduit metal accessories like, bends, boxes, tees, o different sizes.

3. Copper wire for earthing 10 and 14 guage.

4. Steel wire for drawing conductors 18 or 20 gauge.

5. P.V.C. cable 1/1.5 mm^2 and 1/2.4 mm^2.

6. T.W. boards and Round blocks as required.

7. M.S. Boxes of different sizes as required.

8. Wood screws of various sizes required.

9. Wire nails 75 mm.

10. Sunmica sheets suitable for M.S. boxes.

11. S.P.T. and two way switches flush type.

12. Two pin and three pin sockets with plug tops 5A, 15A, 250V.

13. Lamp holders batten, pendent type,

14. Ceiling rose 2 plate.

15. Flourscent lamp fittings complete 40W, 250V.
16. Electric lamps as required.
17. Water tight switches 5A one way.
18. Water tight fittings.
19. I.C.D.P. main switch 15/30A, 250V as required.
20. I.C/porcelain cut outs 250V 5/15A.
21. Distribution board 6 way/12 way, 15A, 250V.
22. P.V.C. twin core copper cable 7/20 for service line.
23. G.I./steel wire 18 SWG. as required as supporting conductor for service line.
24. 'U' bolts sharp edged for fixing pipes in the walls.
25. Check nuts as required for the conduit pipes.
26. Cement and sand as required.

Layout Diagram:

(See attached sheet)

PROCEDURE:

1. Mark the layout diagrams on the walls of the building.
2. Cut the channels on the walls along with the marked lines for laying the conduit pipes, and boxes etc. to the depth of 75 mm for pipes and for boxes to their thickness.
3. Cut the conduit pipes according to the required lengths.
4. Fix the conduits with 'U' bolts to the walls in the channel
5. Fix the M.S. Boxes in the channels with the help of wooden gitties/rawl plug.
6. Draw the fish wires in the conduits.
7. Plaster the channels with proper cement mixture.
8. Cut the PVC wires according to requirment as per the circuit diagram.
9. Draw the PVC wires in the metal conduits with the help of fish wires and also earth wires.
10. Mark for the accessories positions on sunmica sheet and cut accordingly.

11. Fix the accessories on the top of sheet firmly as per the cuttings made.
12. Fix the top boards and give connections for electrical accessories.
13. Draw the service lines.
14. Fix the energy meter, cutouts and distribution boxes.
15. Test the installation with megger for insulation test, continuity test and polarity test.
16. Get the service connected through supply company's mains.
17. Give the supply and test the installation for correct and safe working.

TABULAR RECORD OF OBSERVATION:

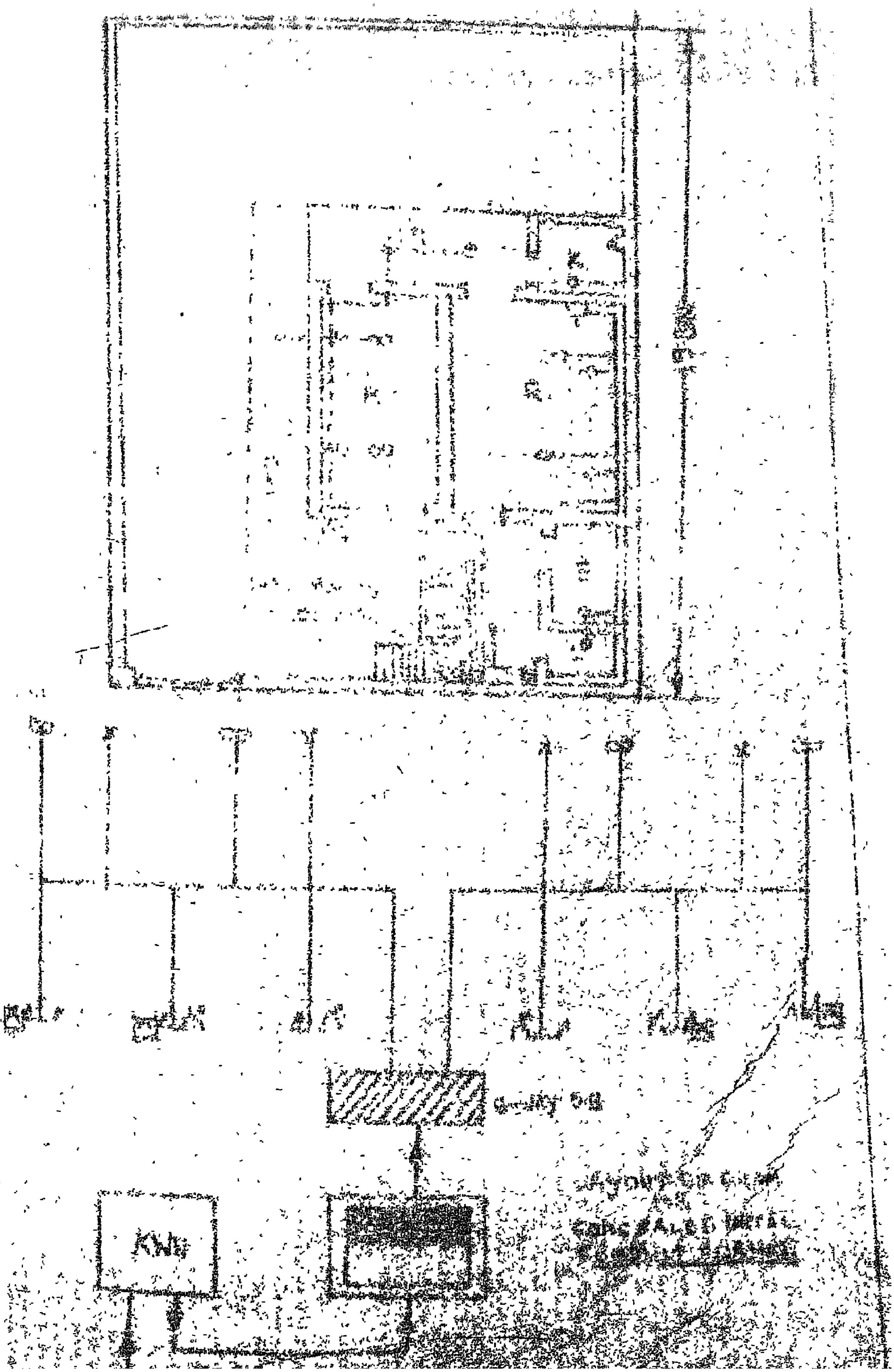
When the installation is completed and tested it was found working satisfactory as per ISI standards and I.E. Rules.

PRECAUTIONS:

1. Marking on the walls should be done according to diagram.
2. All the metalic bodies and pipes should be earthed properly.
3. Use correct size of fuse wire according to connected load.
4. Check the rotation of direction of disc of energy meter.
5. Avoid unnecessary joints in the pipes.
6. Insulate all the joints in the boards with proper insulation.

QUESTIONS FOR EVALUATION:

1. Why layout marking is necessary ?
2. What is the size of copper wire is used for earthing ?
3. Why distribution boards is necessary ?
4. Why megger testing is done before energising the installation ?


KWh
CONCEALED METAL

EXPERIMENT/PRACTICAL NO. 43

TITLE OF EXPERIMENT/PRACTICAL:

Practice for Site position of Poles and Drilling of Holes.

SPECIFIC OBJECTIVES:

1. To enable to select a route for power lines.
2. Marking the position of Poles
3. To drill Holes and Poles for Fixtures.

INTRODUCTORY INFORMATION AND RELATED THEORY.

One of the important phase of the construction of over head lines is planning out well aheads of actual construction plan and prepare the poles ready for fixtures and ready for laying out line

EQUIPMENT AND MATERIALS:

1. 2 ft long pegs 15 to 20 Nos.
2. Maps: For survey of route line.
3. Electric Drill or ratchet Drill if electricity is not available.

PROCEDURE.

1. Select a route and plot it on a map with large scale and then carefully examine the same in detail (see Fig [illegible]
2. From the map, the position of each pole should be decided and a peg about (2 ft. long) should be fixed in the ground. Keep it [illegible] 6" above the ground.
3. Determine the positions of angle and section terminal poles before hand and mark the same on Route Survey map.
4. Check for special features as below:

   (a) If a building or any structure is on the way, the support is to be kept away at a permissible clearance.

   (b) For river crossing, a railway crossing special pole supports as per regulations be used.

5. Before bringing poles to the site, drilling of Holes be completed for setting of fixtures such as crossarm, knee Bracing and D-shackle Bolts.

6. Keep the size of the Hole 1/16" bigger than the size of the bolt i.e. for a bolt of a diameter of 5/8" a hole of 11/16" may bedrilled.

7. Number of Holes in poles be drilled as required by the design of the line.

TABULAR RECORD OF OBSERVATION:

Drill the Holes in the poles as under:

1- Hole for cross-arm bolt.
2. Hole for knee bracing.
3. Hole on top cap of the pole for top pin of the insulator.
4. One hole each for number of phases (i.e. 3 holes for 3 phases and 2 for a single phase line)
5. One hole for street light line whenever street light is to be provided.

6. One hole for neutral wire.
7. One hole for earth wire spool.

All the holes given above are not to be drilled in each and every pole. Three Nos. illustrations as given in Fig. 2to 4 be practised.

PRECAUTIONS:

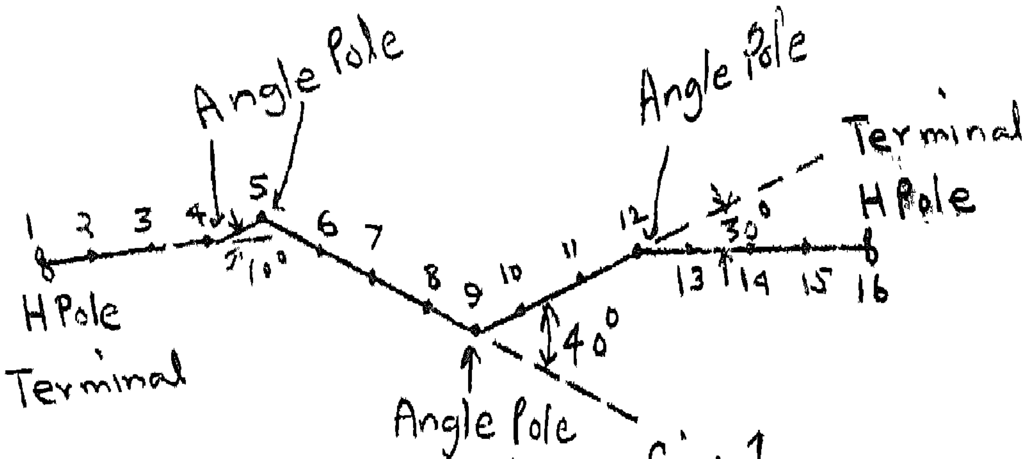
In selecting the route of the line, avoid sites like wells, steep slopes, and bridges, water logged areas, low lying areas, trees as far as possible.

2. Keep the route as near to the road as possible and line route should pass near as many villages as possible.

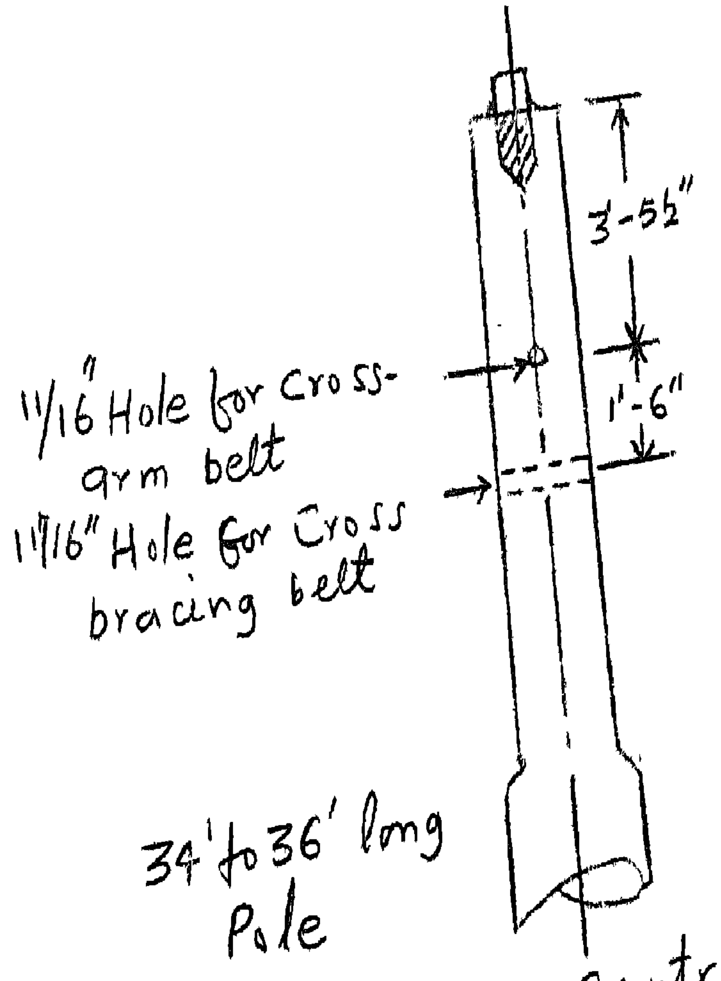
3. Hole of cross-arm and of knee bracings is to be at right angles to each other.

QUESTIONS FOR EVALUATION:

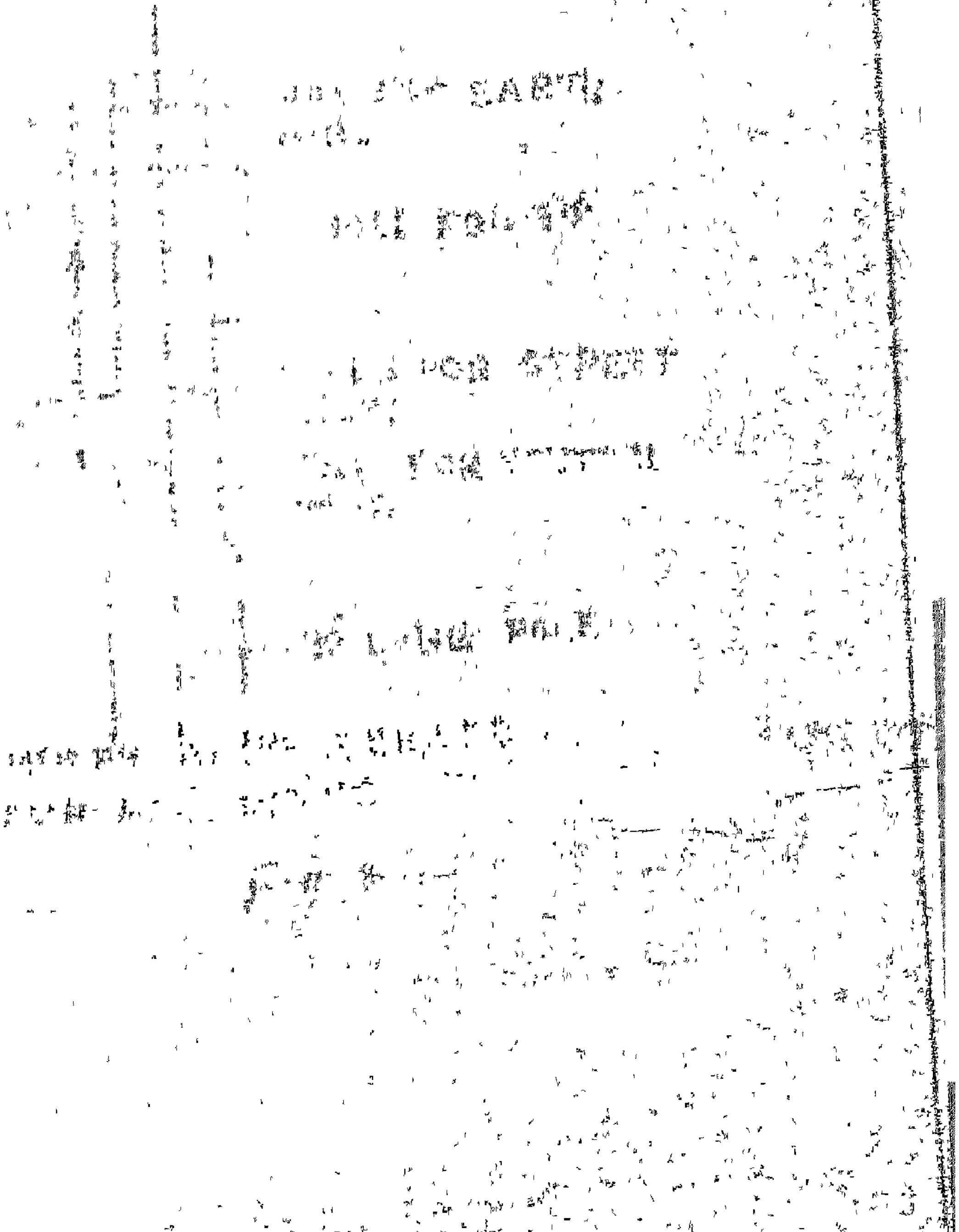
1. Why peg marking should be done ?
2. Why route should be near to the road ?
3. On what factors, nos. of Holes depend ?

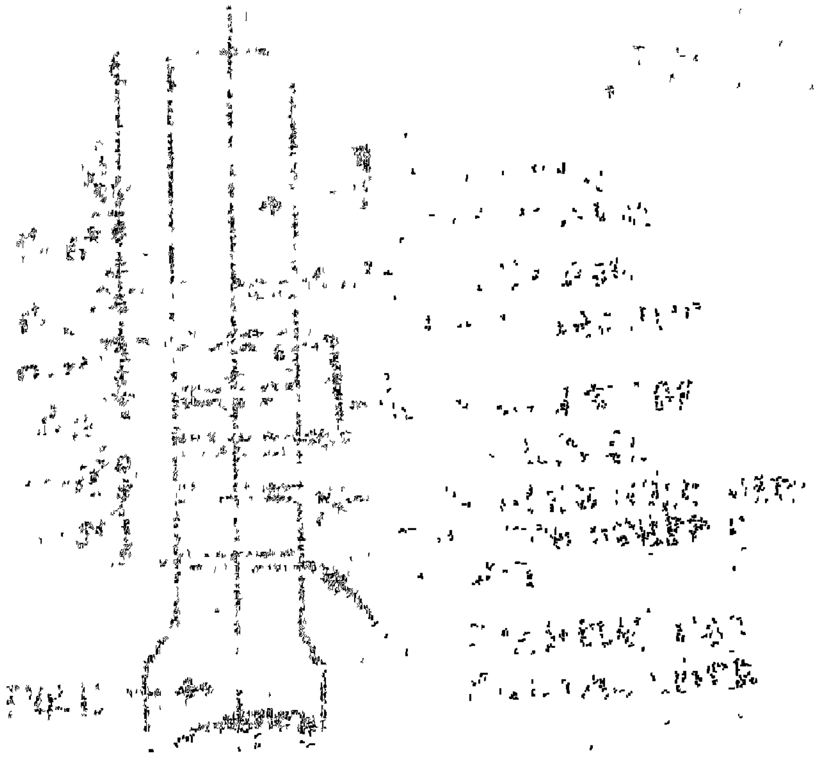


Route Map of the Line : fig: 1


3'-5½"
1'-6"
11/16" Hole for cross-arm belt
11/16" Hole for Cross bracing belt
34' to 36' long Pole

Poles for Cross-Country Line : fig: 2.


EARTH



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EXPERIMENT/PRACTICAL NO: 49.

TITLE OF EXPERIMENT/PRACTICAL :

Practice of digging holes and erection of poles.

SPECIFIC OBJECTIVES:

1. To provide systematic techniques for erection of poles, for overhead lines.
2. To expose to the theory of erection of poles techniques so that depending upon the available circumstances/environment, the best may be implemented.
3. To make a base for economical and accident free utilisation o labour during erection.

INTRODUCTORY INFORMATION AND RELATED THEORY

After the route survey of line to be erected has been done, the poles have to be erected so that further action of stringing a sagging of conductor may be taken.

EQUIPMENT AND MATERIALS:

1. Drilling machine,
2. Earth auger, digging bars, shovels or pick axes,
3. 3 ropes of 3/4" diameter and one of $1\frac{1}{4}$" diameter sizes each of nearly 40 ft to 50 ft long.
4. X-shape wooden frame,
5. Hoisting rig, a truck or a skid winch or a derrick pole.
6. Standard tools and plants e.g. hammer, etc.

Diagram:

(see fig. 1 to 4 on attached sheets)

PROCEDURE:

1. Transportation of poles:

All other material can be transported easily either in a truc or a bullock cart. For poles, (though this can be done by the above mentioned method) it is recommended that a special trol should be got made and may either be pulled by bullocks or a tractor or by ordinary labour. After the necessary poles are transported the actual construction starts.

2. Preparation of poles for erection:

After the poles have reached the site of the following operations should be completed as described in previous experime

- a) Drill the holes.
- b) Paint the pole if not already done,
  (Not needed if P.C.C. i.e. cement pole is used)
- c) Fit the cross-arm and knee bracings.
- d) Fix up the pins and clamps for insulators,
- e) If the muffs are provided, they should be grouted on the poles. If not grouting should be done later on.

3. Digging of Holes:

After fixing the point where pole is to be erected the hole is to be excavated in the ground. The depth to which the pole is be planted is a matter which can only be determined in the light local knowledge. Roughly 1/6th of the length of the pole is planted. In case of solid rocks the depth is less. The following table shall be useful in digging the holes in the ground.

Length of pole (feet)	Depth in ground in solid earth (ft)	Depth in ground in solid rock (feet)
25	5	$3\frac{1}{2}$
30	5	$3\frac{1}{2}$
36	6	4
42	7	$4\frac{1}{2}$
65-70	8	6

In ordinary firm soil, pole holes are excavated by:

1. hand using digging bars, shovels or pick axes,
2. earth augers,
3. drilling machine.

If the hole is by manual labour then it should be $3' \times 1\frac{1}{2}'$ size and should be tapered. If it is by earth auger or drilling

The hole should be of the same diameter at the top at the bottom and should be sufficiently larger than the pole to allow the use of tempering bars to tamp the back shoveling. If the pole base (see fig.1) is to be used that may be fitted, otherwise the concrete pad of 3" thickness may be placed in the hole at the bottom.

4. Raising of Poles:

Four ropes 3 to 3/4" diameter and one of 1¼" size, 40 to 50 ft. long are tied near the top of the pole.

Then the pole is raised by about 5 to 6 ft. on a wooden frame of x-shape. One or two men depending upon the weight of the pole should hold 3/4" rope in 3 different directions and 3 to 4 erectors should hold the 1¼" rope in the 4th direction. Then the pole may be pulled by these people till it gets into the pit.

A hoisting rig, a truck or a skidwinch can also be used with advantage. A derrick pole can also be used with advantage. This pole being lighter, is first erected and then by pulling the pole which is to be erected, the derrick pole is lowered (See fig.).

2. It becomes easy to lift the pole(see Fig.2 and 3) .

5. Checking of pole alignment:

As soon as the pole is erected, it should also be checked for verticality by a plumb-bob.

6. Concreting the pole:

Poles should have strong foundation, because the failure may not necessarily be due to fracture but due to the foundation. If the muff is pre-cast, this is to be fitted to the pole before the erection of the pole. Then only the earth is to be tamped. It is better to tamp in more soil than comes out of the original hole. If the pole has not been fitted by pre-cast muff, then it should be grouted by cement concrete mixture in the ratio of 1:2:4 (see fig.4)

If the hole is done by means of an earth auger or drilling rig then it should be grouted without the aid of a steel muff but if a larger hole has been dug, then a steel plate muff of 10' diameter or depending upon the size of the pole may be used.

This steel muff may be removed next day. The baulk should be one foot above ground level. It is essential that this casing should be bevelled at the top to prevent lodgement of water between the concrete and the pole surface.

TABULAR RECORD OF OBSERVATIONS :

After erection of poles, record observations in the following tabular form:

Details	Pole No. 1	2	3
1. Length of pole	30 ft		
2. Type of pole, whether PCC/Steel	Steel		
3. Height above ground	25 ft		
4. Depth in ground	5 ft		
5. Whether Muff provided or not	Yes		
6. Type of X-arm	Horizontal		
7. Whether angle pole or not	No		
8. Nos of holes drilled	5 Nos		
9. Paint done or not	Done		

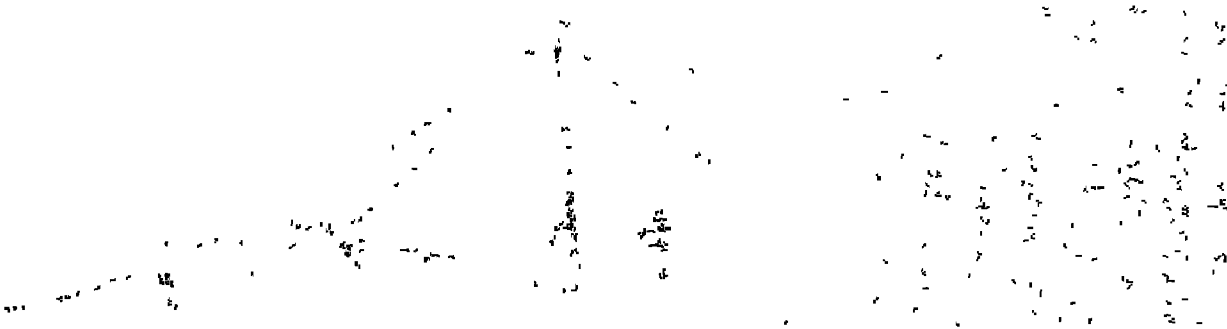
PRECAUTIONS :

1. Ropes should be a proper size and no. of persons handling should be enough.
2. Muffing be provided as necessary.
3. One coat of paint must be done to steel poles.
4. Proper numbering must be put on the poles.
5. Record of data regarding each pole must be prepared carefully.
6. Holes must be dug up to proper depth.
7. Take safety measures to avoid accidents.
8. To have proper coordination and economical utilization of manpower, one person from the gang of erectors must be made leader so that other work under his command.

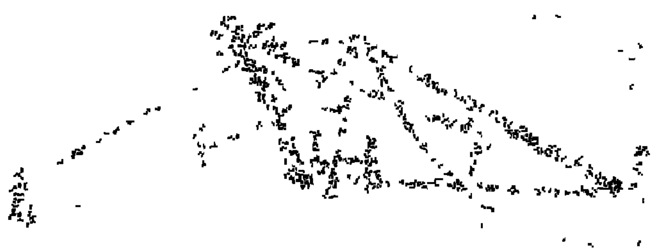
QUESTIONS FOR EVALUATION:

1. What should be the normal depth of the pole below ground ?

2. What is the necessity of muffing ?
3. How you will check verticality of the poles after erection ?
4. How derrick pole be advantageous as compared to other techniques ?
5. Name any two different methods of muffing ?
6. Name any three different tools to dig the holes ?

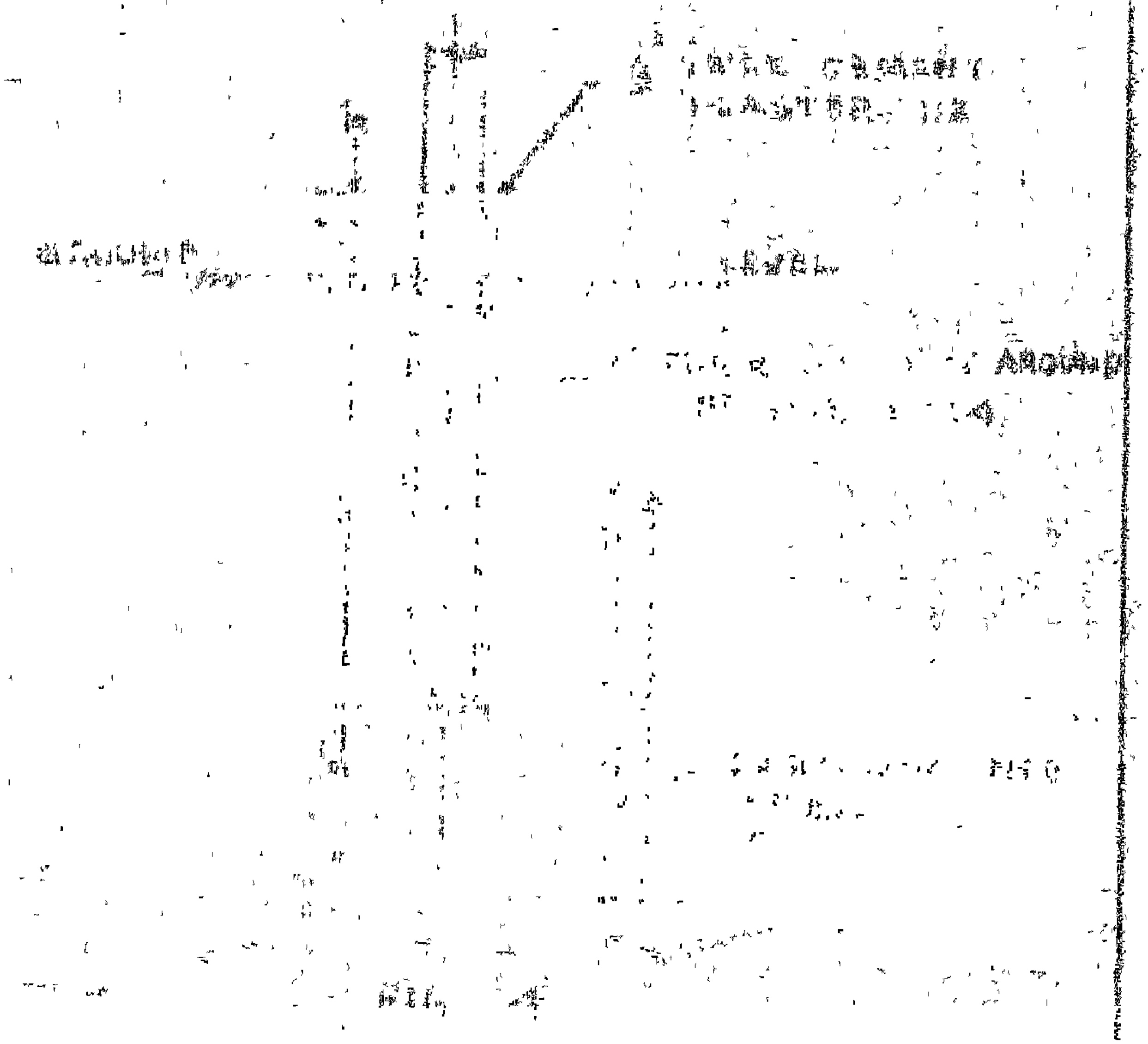


[illegible] THE POLE . BY PATRICK POLE



[illegible] THE POLE HAS BEEN RAISED

HIGHER THAN [illegible]



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EXPERIMENT/PRACTICAL NO: 50

TITLE OF EXPERIMENT/PRACTICAL

Practice of fixing different fittings on poles such as crossarms, insulators, stay-wires, guy rods/wires.

SPECIFIC OBJECTIVES

1. To acquaint the learner with different kinds of fixture/fittings in use for overhead lines.
2. To impart know how about how to fix these fittings on poles.
3. To enable to make economical utilization of manpower and materil by following systematic procedures for fixing these fittings.
4. To complete one important phase of erecting overhead lines.

INTRODUCTORY INFORMATION AND RELATED THEORY:

The main function of a pole is to support conductors at a safe distance above the ground. Conductors also must be kept a safe distance apart. This is the function of crossarm. Several designs are in use. They vary from steel channel to V.U and zig-zag shape or teak wood or sheesham wood crossarm. In order to prevent arcing, the construction should be such that under the worst conditions, the distance between wires, when swinging, could never be less than the following figures.

3.3. KV	7.5. cms.
6.6. KV	7.5 cms.
11 KV	10 cms.
33 KV	19 cms.

and so on

Guys are used whereever the wires tend to pull the pole out of its normal position and to sustain the line during the abnormal loads caused by sleet, wind and cold. Guys may be classified as Braces; wire guys; Anchor or down gy and stub gy.

Braces are used whereever wire guying is not convenient such as along lines paralleling a highway or in marshes where anchors cannot be firmly embedded. A span guy is a wire guy running from the top of a pole to the top of a adjacent pole and is used at important crossings. A head guy is a wire guy running from the top of a pole to a point below the top of the next pole. An arm guy is a wire guy running from one side of a crossarm to the next pole. An anchor or down guy is a wire guy running from the top of a pole to an anchor in the ground. Line guys are installed in straight pole lines to reinforce the line against stresses due to broken conductors etc. Side guys are used to reinforce a pole line against an unbalanced side pull of the conductors. Such pulls are developed at curves, angles, whereever there is a turn in the line. A storm guy is a combination of line and side guys. A stub guy is a means of obtaining clearance for a wire guy. A sidewalk guy is anchor guy with a horizontal strut at a height above a sidewalk to clear the walk.

A wire guy consists of cable, cable clamps, strain insulator and the anchor. The function of an insulator pin is to hold the insulator mounted or it in a vertical position. Insulator pins in use in field are of metal. e.g. iron and steel. The function of an insulator is to insulate the line conductor from each other and from the pole or tower. Three classes of insulators are used on overhead lines, namely, Pin type, suspension type and strain type. The pin insulator gets its name from the fact that it is supported on a pin. The pin holds the insulator, and the insulator has the conductor tied to it. Pin insulators commonly in use these days are made of porcelain. The suspension insulator as its name implied is supported from the x-arm and has the line conductor fastened to the lower end. They are mainly used for high voltages above 33 kv as at this voltage the pin insulator becomes quite heavy and it is difficult to obtain sufficient mechanical strength in the pin to support the insulator. The use of suspension insulators eliminates the use of the pin and makes possible obtaining any distance between the conductors and the pole or tower by merely increasing the number of insulators in the 'string' as the complete unit is called. Strain insulator is used where a pull must be carried as well as insulation provided. Such places occur where a line is dead-ended, at corners, at sharp curves, at extra long spans, as at river crossings or mounteneous country etc. In such places the insulator must not only be a good insulator electrically, but must also have sufficient mechanical strength to counterbalance the forces due to tension in the line conductors.

A guy is a brace or cable fastened to the pole to strengthen the pole and keep it in position.

EQUIPMENT AND MATERIALS:

1. Cables, cable clamps.
2. Strain insulator,Anchor rod,
3. X-arms, drilling machine.
4. Line construction tools kit.

DIAGRAMS

See attached sheets.

PROCEDURE

1. Complete drilling of holes before shifting poles to site for erection as already described.

2. Decide the length of x-arm to be used and use a templet for boring holes. For 11 KV lines, the length of the x-arm is nearly 5''but for special requirement a length of 7' and 10' be also used. For 33 KV line 7' long x-arms and of knee bracings to be at right angles to each other.

3. Use H-poles where unusual loads have to be withstood e.g. at angles or at line terminal corners, branch lines etc. Alternatively, single poles supported by wire guys or pole struts can be employed, A strut is one of the line poles and is simply converted by fitting a head piece.

4. The installation of a guy involves five operations: Digging in the anchor:, inserting the strain insulator in the guy wire, fastening the guy wire to the pole; tightening the guy wire and fastening to the anchor; and mounting the guy wire guard. Guy wires should be placed on the poles and stay rod fixed before the line conductors are stretched on the poles. This is important as otherwise if line wires are placed first, the poles would be pulled out of position. The arrangement of guys is that the guy hook bolted through the bolt or may be fixed to a clamp. Thimbles are used at both the ends of the guy wire as otherwise strands get damaged. The guy wire is tightened from the ground by means of an anchor with stay rod. The anchor rod is projected far enough above the ground level, so that the guy wire does not come into contact with soil of the ground.

5. An egg type strain insulator is inserted for safety. Two ends of guys be threaded through the insulator in such a way that the porcelain of the insulator is under compression, making it possible to withstand a larger pull. In case the procelain breaks, the guy will still be effective because of the linking of the two ends.

6. The guy is drawn up until the pole is pulled over slightly towards the guy to keep the proper tension.

TABULAR RECORD OF OBSERVATIONS:

Instructor should ask trainees to do on the job erection and then tell them to prepare diary report. They should prepare a pole wise details of the fittings provided.

Sr.No.	Fittings	Pole No.	1	2	3	4
1.	Cross arm		Yes			
2.	Guy wire		Yes			
3.	Knee bracing		Yes			
4.	Pole clamps		Yes			
5.	Guy insulator		Yes			
6.	Thimble		Yes			
7.	Stay Rod		Yes			
8.	Lock nut		Yes			
9.	Stay bow		Yes			
10.	Anchor Plate		Yes			

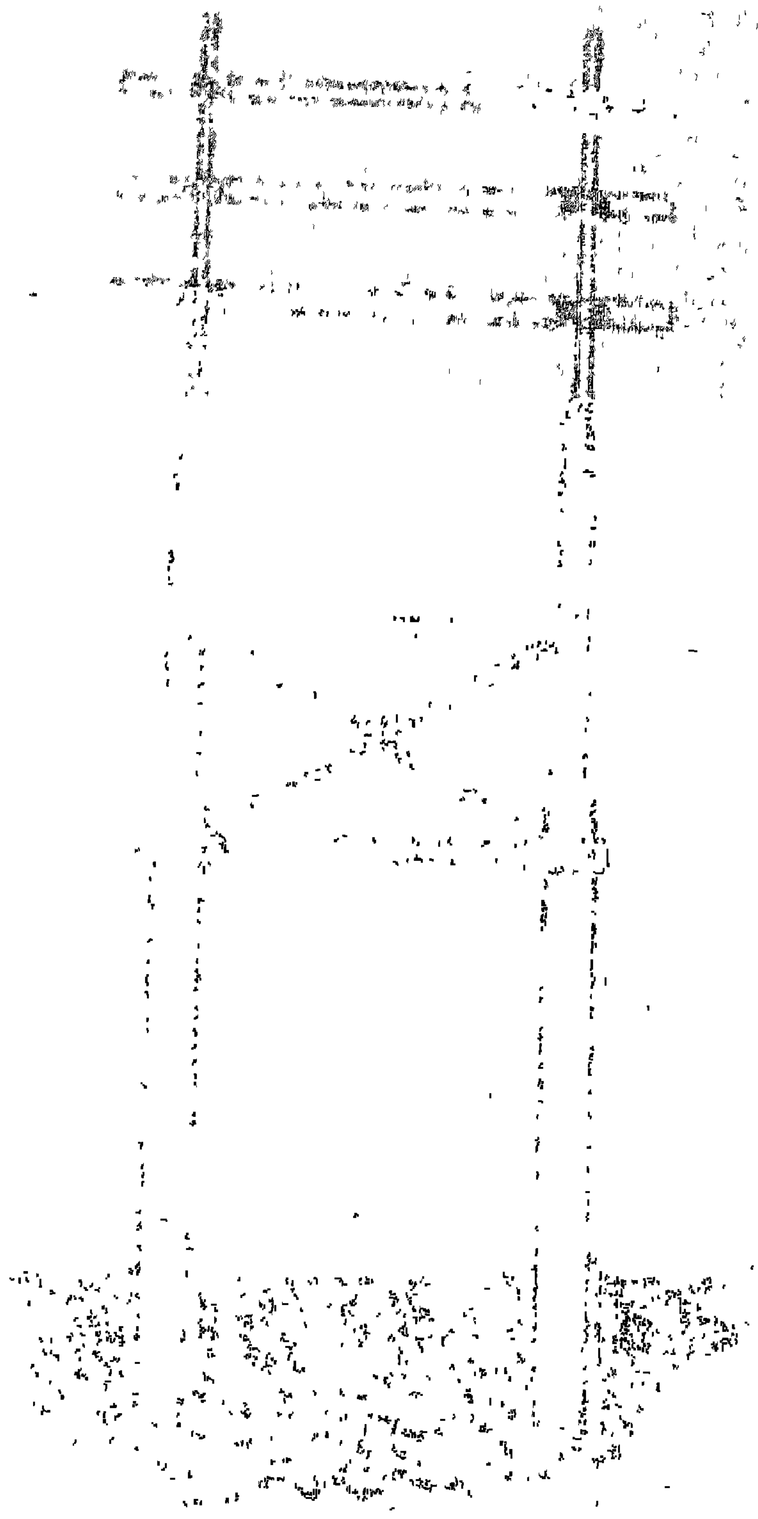
If some fixture is not provided, then NO be mentioned in the table.

PRECAUTIONS:

1. Hole of x-arm and of knee bracings be at right angles to each other.
2. Guy wires should be placed on the poles and stay rod fixed before the line conductors are stretched on the poles.
3. Thimbles be used at both ends of the guy to avoid damage to strands.
4. Use strain insulator for safety.

QUESTIONS FOR EVALUATION

1. Why x-arms are used and where guys be provided and why ?
2. What should be the position of holes for x-arm and a keen bracing
3. Name different forms of guys in use.
4. What is the function of a strain insulator ?
5. Name the steps for fixing guys.
6. Why guy wires should be placed on the poles and stay rod fixed before the line to conductors are strentched on the poles ?



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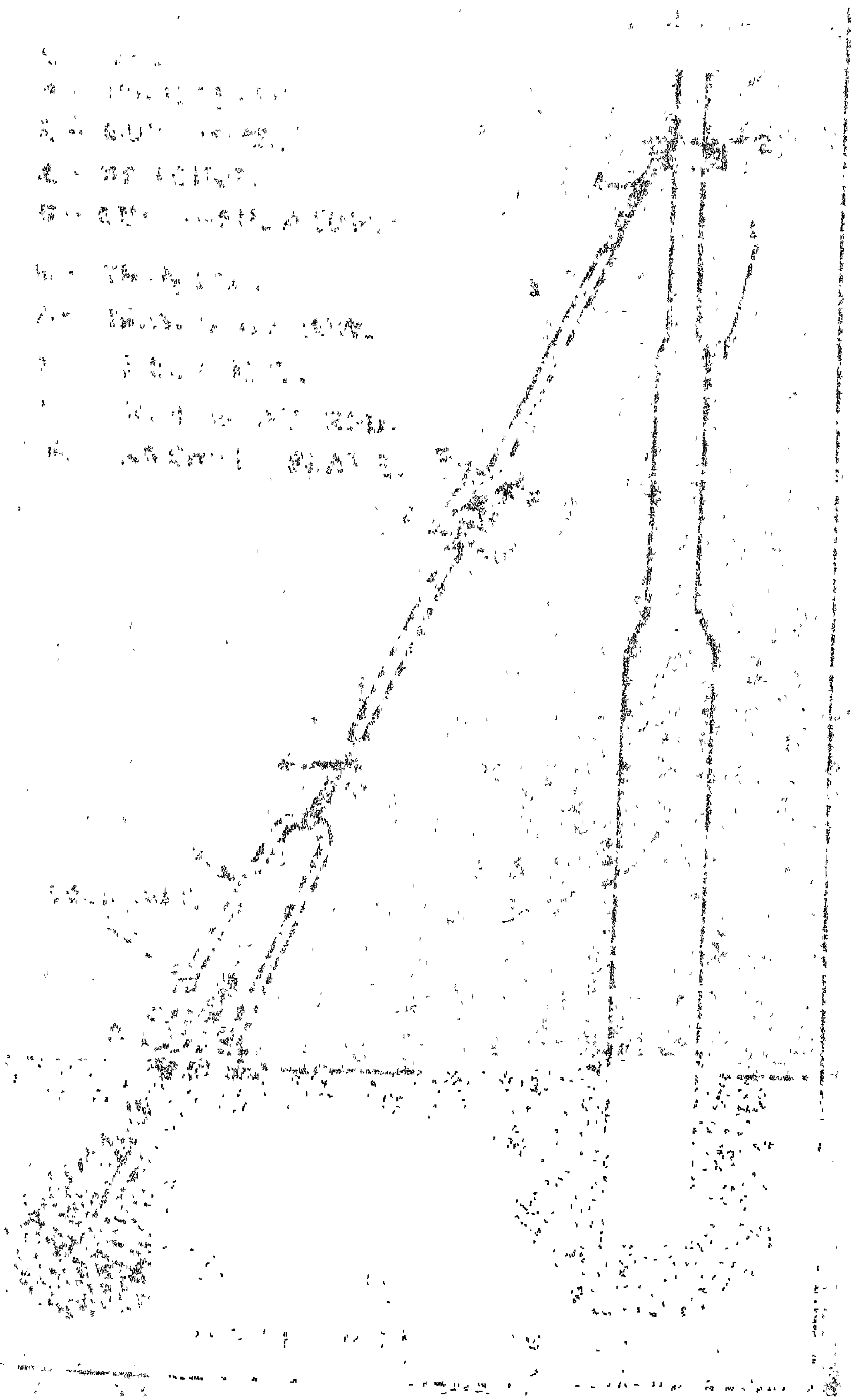


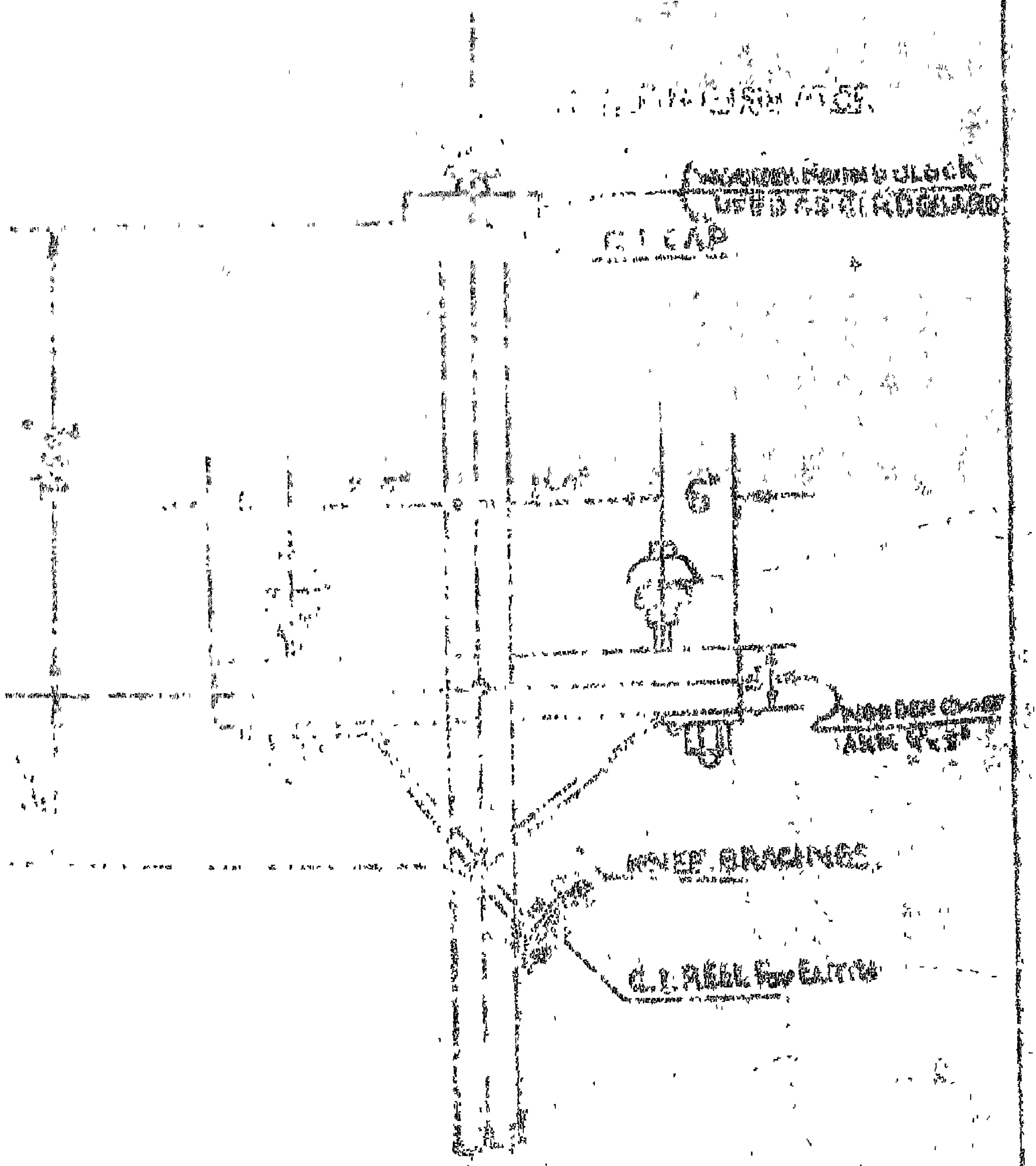


Fig-5 Arrangement of 11 K.V Line.

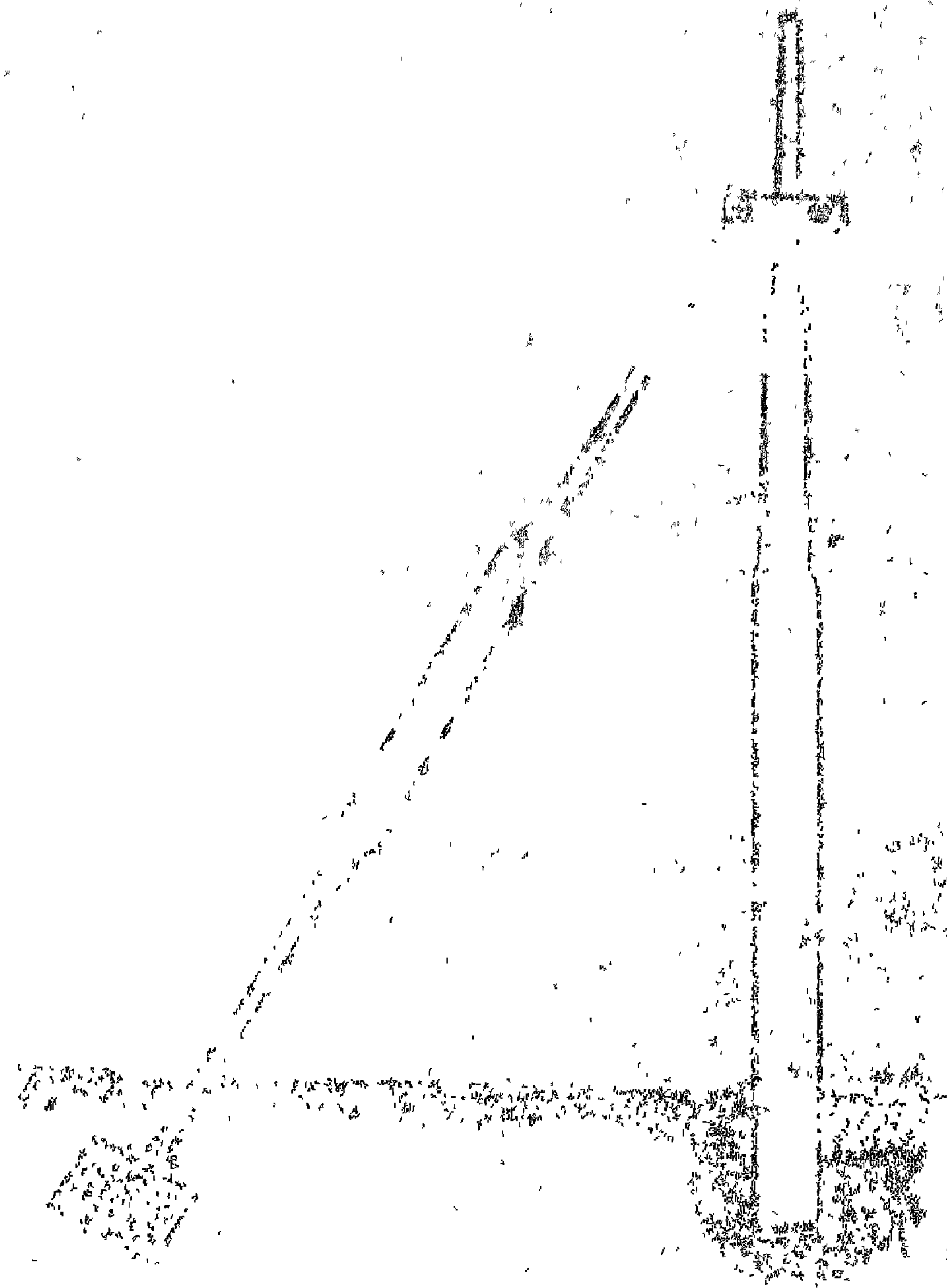
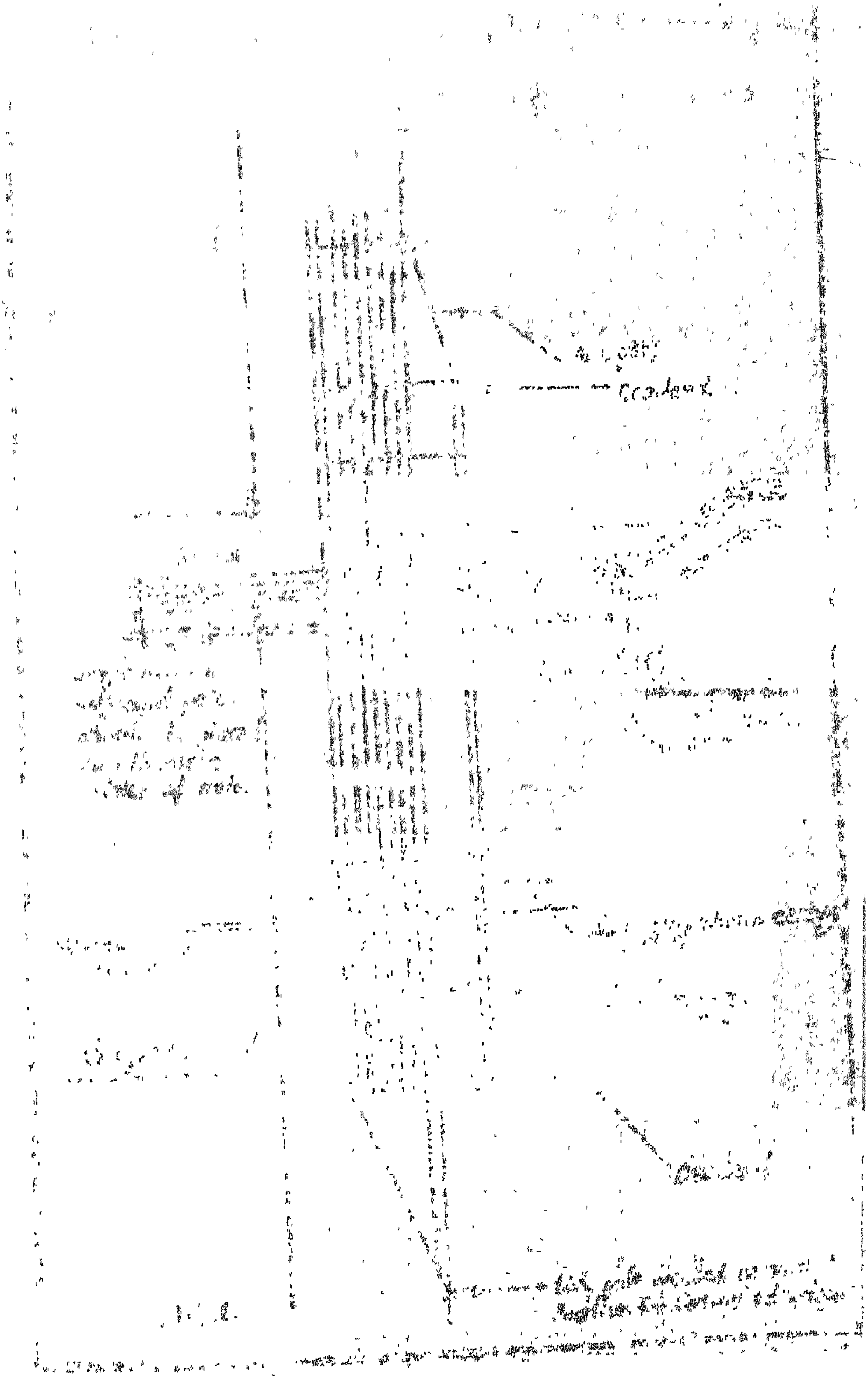


Fig. 1



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EXPERIMENT/PRACTICAL NO: 51

TITLE OF EXPERIMENT/PRACTICAL

Practice of Testing the Alignment of Poles.

SPECIFIC OBJECTIVE :

To ensure perfect alignment of poles during the erection of poles.

INTRODUCTORY INFORMATION AND RELATED THEORY:

After a pole is raised, the facing, straightening up and lining in are done by the setting crew. Such a crew usually consists of three, four, or five men. For men working from the four 'sides' of the pole hold the pole in an upright position with pike poles resting on the ground. Two men line the pole in, one along the line and the other from the side. One or two men turn the pole with the use of cant hooks. Next comes the testing pole for perfect alignment.

EQUIPMENT AND MATERIALS:

1. Vertical rod
2. Plumb and align pole
3. Crew of about four or five men.

DIAGRAM

See figs. 1,2,3 on attached sheets.

PROCEDURE

In order to ensure perfect alignment procedure shown in figs. 1,2,3 be followed:

Pole has already been set plumb, Pole b is being set plumb and vertical rod a (fig 2) set on the surveyed line is being used to direct the alignment and plumbing of the pole b by slighting from a to c.

Now perform the following operations:

1. Turn the pole so that the gains face the directions outlined above. In a straight line, adjacent poles are to be faced in opposite directions. If the pole is being raised without the X-arms in place, a light slot can be nailed in a gain to guide the lineman in facing the pole. This is important because the X-arms should be placed at right angles to the line.

2. Move the butt of the pole so that the pole will be line. The pole may be shifted in the hole by prying it over with a heavy bar. An easier method is to butt the pole. This is done by pushing the top of the pole in the opposite direction that the butt is to be moved. By so doing the pole willpivot on the edge of the hole and force the butt over in the desired direction.

3. Now the setting crew is straightening up the pole. This is generally done by sight by the man in the line and the man on the side (see fig.1). One pair of men at the pikes take signals from the man sighting from the side, the side liner, and the other pair of pikers from the man sighting along the line, the head liner. The head liner should be about the length of one span ahead when he is lining the pole in. In case of a straight line, he should be standing over the next pole or in line with it. The side liner should be about 30 or 40 paces out from the pole. These two men sighting direct the four men at the pike poles which way to push the upper end of the pole. Poles shall be set to stand perpendicular when the line is completed - so that no pole be more than 5 cms. out of line with the others.

4. In setting poles on a hillside or a sloping surface for a background to sight against, great care must be excercised, or the poles will be set leaning to one side, to avoid such difficulty the men sighting should make use of a plumb bob. A pieceof lead or iron tied to the end of a thin string makes an excellent plumb bob, for this purpose. Sometimes a watch suspended by its chain will serve very well unless the wind is blowing considerably.

TABULAR RECORD OF OBSERVATIONS:

Instructor should arrange practical working for the trainees and they be asked to write a dairy report about the method used by them.

PRECAUTIONS:

When the pole is properly lined in, the pike poles be left in position to hold the pole in place during the back filling and temping operations.

QUESTIONS FOR EVALUATION

1. Why alignment testing is required ?
2. Name three methods of checking verticality of poles.
3. Why poles should be in line ?
4. What distance is permitted for poles to be out of line ?

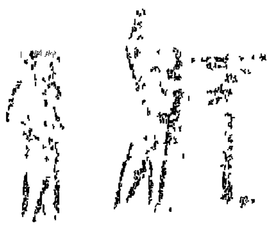

FIG. 1

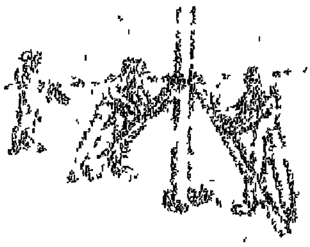

FIG. 2

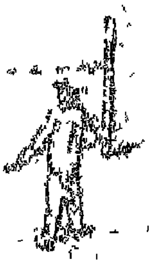

FIG. 3

Procedure adopted in handling and [illegible] [illegible].

1. [illegible] rod to keep [illegible] [illegible] [illegible] of pole.
2. Guard and align pole.
3. Pole has already been set and plumbed.

EXPERIMENT/PRACTICAL NO: 52

TITLE OF EXPERIMENT/PRACTICAL

Practice of stringing and sagging of overhead line conductor.

SPECIFIC OBJECTIVES:

1. To know how to reel out conductor, string it for sagging in overhead line construction.
2. To know sagging and tying the line conductor.
3. To know a systematic procedure for overhead line erection so as to make best available use of manpower, material, in from economy as well as quality view point.

INTRODUCTORY INFORMATION AND RELATED THEORY:

After the poles have been erected and fixtures set on the poles the most important phase of line construction starts which is stringing and sagging of line conductor. This phase involves, reeling out of the conductor, stringing it so that over-head line is erected as per specifications. Final phase of tying in is also needed before the line is ready.

2. Reeling out conductors:

The reeling out of the conductors may be accomplished by either of the two methods:

a) Moving the reels with conductor stationary.
b) Pulling conductors from stationary reels.

The first method involves following steps :-

1. Mount the reels of wire on a truck or carriage in such a manner that the reels are free to rotate.
2. Fasten the ends of the conductors to a pole, tower footing or other fixed object.
3. Drive the truck slowly along the route of the line, allowing the conductors to unwind as the reels are moved forward.

Conductors in this method are not dragged over the ground, causing scratching or damage. They are simply laid out on the ground without being pulled over it.

The second method involves the following steps:

1- As the reels on which conductors are wound remain in a fixed position so these are raised off the ground or supported in their carriages in such a way that they are free to rotate.

2. Pull out conductors, thereby rotating the reels and unwinding the conductors.

3. Either simply draw the conductors forward, sliding or dragging them over the ground or keep these suspended in the air in tension so that they will not touch the ground. Be careful that

the conductors don't get scratches as it will not only damage conductors in use these days, suspension in air method is better.

2. Stringing and Hoisting Line Conductors:

It is common practice to use tension stringing method for overhead lines. Tension stringing is the process in which conductors are kept off the ground through out the entire stringing operation. To keep the conductors in tension, This requires a puller on the leading end of the conductor and a brake or tension on the trailing end of the conductor. Before stringing operation is begun, a pulling line of wire rope for transmission lines or manila rope for distribution lines is attached to the leading end of the conductor and is run through stringing sheaves hung from each tower or pole X-arm for the full distance from the tensioner to the puller. It is the function of the pulling line to pull the conductor into the stringing sheaves as it is pulled forward by the puller.

As the conductors are reeled out, they are hoisted upto the X-arm. Each time a pole or tower is reached, the truck or tractor pulling the conductor, pulls a little ahead and halts to permit each wire or cable to be hoisted. This is generally done by means of handline. Hoisting of conductor to X-arm is called ' Laying up'. The common practice is to use snatch Block for ' Laying up' or Rope Baskets in city areas where it is not possible to switch off supply all the time. In this way, instead of placing conductors directly on X-arm which may damage the conductors due to scratches, conductors are hung in so called snatch Blocks. A snatch Block is a single sheave Block so arranged that it opens in one side thereby, permitting the conductor to be inserted or removed without threading it through. Snatch Block serves two purposes:
1. It is a support for the line conductor (2) the pulley on the blocks runs so easily that it aids the conductor in taking on a uniform tension throughout attaching to the suspension insulator. Rope Basket consists of two parallel ropes supported from the ends of the X-arms in the crossing span with numerous cross ropes to cater or support the unstrung conductors.

2. Pulling p of Conductor:

After the conductors are hoisted, they are ready to be pulled up. To carry out this operation a come-along, or pulling grip is fastened to the end of the line conductor. There are several makes of come-alongs in general use. All are designed with parallel jaws that will grip the wire firmly without injuring it.The conductors may be pulled from the top of the pole in the case of short line extension. The pole used to pull from must be properly guyed to withstand the strain. If there is quite a bit of pulling to be done, however, as in new construction,,it is better easier, and faster to pull from the ground. The block and tackle or chain jack can be handled more easily on the ground than on the pole. After the conductors are pulled to the proper tension or sag, the conductors can be snubbed to the bottom of the pole to which the block and tackle is attached. Care should be taken in pulling up that splices and sleeves - do not catch on X-arm or in the sleeves of snatch blocks. Any catch of this sort may prevent the conductor from coming up as it should.

After the conductors are pulled, they should have 1/2 to 4 hrs. or more depending upon the length of the pull, to allow them to creep. This creep will make the tension and sag in each span uniform.

When possible, an equalizer may be used in pulling up conductors in order to produce the same tension on each conductor. A simple form of equalizer for two conductors consists of a rope with a come along on each end to grip the two line wires. The rope runs over a snatch block to which the pulling tackle is attached. Since the rope is free to move through the snatch block, the conductors will pull up to the same tension.

4. Sagging the Conductor:

Conductors are sagged correctly, when the tension is the same in each span throughout the entire length. New conductors must be prestretched so as to remove the non-elastic stretch. Several different methods are used in practice,sighting,use of transit, timing waves and use of dynamometer.

In locak practices, only sighting and use of transit is followed.

In sighting for sag it is well to select a span near the middle of the length pulled up. The length of wire pulled at one time may vary from a few hundred feet to a half mile or more. Preferable, a span near the middle of the length pulled should therefore be selected in sighting for sag. If the section includes a number of curves, it is desirable to sag at more than one point. A simple and accurate method of measuring the sag is by the use of targets placed on the poles below the X-arm. The targets may be a light strip of wool like a lath nailed to the pole at a distance below the conductor when resting on the insulator equal to the desired sag. The lineman sights from one lath to the next. The tension on the conductor is then reduced or increased until the lowest part of the conductor in the span coincides with the lineman's line of sight.Sagging T's can also be used the same as targets except that Ts are hung on the line conductor.

In case of H frame line, where the line conductors are on one or the other sides of the poles. A lineman stationed on one pole and looking to corresponding pole, a span-length away cannot include the lowest point of the conductor in his line of sight. To get around this difficulty, a transit is securly fastened to the pole at a distance equal to the desired sag below the conductor support. Then the transit is levelled. To observe the sag, the transit is sighted at the conductor at mid-span and then is swung around until in line with the pole a span length away. The sag is then observed and the line conductor is drawn up farther if the sag is too large or relaxed if the sag is too small

5. Releasing Pulling Blocks:

After the conductors are pulled up, provide a temporary dead end to hold the conductor until the next stretch of wire is pulled up and held. Temporary dead end be arranged for by running a head guy from the top of the last pole 'a' to the butt of next pole 'b'. A lineman then climbs pole (a) and hitches a come-along to the X-arm by means of a rope sling and then reaches out and slides the come-along along the wire as far as possible so that the grip will hold the wire when the pulling blocks are released. After dead-ending or snubbing the completed, the pulling blocks should be gradually released. Avoid release with a jerk, otherwise an abnormal stress may be placed on the conductors and their supports which might result in a failure such as the snapping of a pin, a X-arm, a guy, or even a pole in extreme cases.

6. Tying IN:

Conductors should occupy such a position on the insulator as will produce minimum strain on the tie wire. The function of the tie wire is only to hold the conductor in place on the insulator, leaving the insulator and pin to take the strain of the conductor. Common practice is to use wire ties throughout in the distribution systems and almost entirely on the transmission lines when the pin insulator is employed. For suspension insulators, clamps are used. Different kinds of ties are in use. The point is that it should be easy to apply and relating simple to made keeping in mind its function that it should bind the line conductor securely to the insulator and in addition, should reinforce the conductor on both sides of the insulator. However, tie wire should be the same kind of wire as the line wire. Never use a tie wire second time.

EQUIPMENT AND MATERIALS

1. Poles duly erected and fittings fitted on them.

2. Line conductor.
3. Pulling Blocks.
4. Snatch Block.
5. Ropes.
6. Tie wires.
7. Vehicle for carriage e.g.truck.
8. Light strips of wood to serve as targets.
9. Come-along or pulling grips.
10. Block and tackle or chain block.
11. Lineman Handtools, kit bag.
12. Safety Belt, Body Belt etc.

PROCEDURE

1. After the poles have been erected, fixtures have been set on the poles, then reel out and stretch the conductor along the line using any method described earlier, depending upon the availability of equipment in the given circumstrances. If a truck or carriage is available, then use the method of moving the reels with conductor stationery, In our country side for small rural area lines, the practice adopted is to take conductors in bundles to site of work after reeling out manually in stores and then stretch it manually.

2. Use tension stringing and Hoist the line conductors on X-arm thus laying up the same. Use snatch Block instead lying up directly on X-arms.

2. Perform pulling up operation for line conductor using come along or pulling grip, block and tackle or chain block as per availability. To produce same tension in line conductors, use equalizer.

4. Perform sagging operation using sighting method in general and transit method whereever H-poles frame is there.

5. After sagging is done, release pulling blocks.

6. Perform trying in operation at every pole using tie wires of nearly 3 ft. long.

TABULAR RECORD OF OBSERVATIONS:

Following measurement be recorded for all the material used :-

Sr.No.	Item	Qty.
1.	Poles	10 nos.
2.	Aluminium conductors	3000 mtrs.
3.	X-arms	10 nos.

PRECAUTIONS:

1. Avoid scratching of the conductor by coming into touch with the ground as it may damage or injure the line conductors.
2. Sagging should be done with equal tesion in all the line conductors.
3. Tie wire should be of the same material as the line wire.
4. Release the pulling blocks slowly and not with a jerk as it will put abnormal stresses on the conductors and supports which may lead to failure such as snapping of pins.
5. Measurement record of the material used on the line must be completed.
6. Conductors be not allowed to lay up on steel X-arms as it may damage them.

QUESTIONS FOR EVALUATION

1. Name the different operations/steps for stringing and sagging of line conductors for overhead line.
2. What is the function of ties ?
3. Why line conductors be not stretched touching the ground ?
4. Where and why Rope Baskets are used ?
5. What should be the material of tie wire ?
6. Name two methods of sagging.
7. Define tension strining.
8. Why pulling Blocks be not released with a jerk ?

Note: For pictorial view of the steps in sagging and stringing of over head conductors, refer to " Lineman's and Cableman's Hand Book KURTZ, McGraw Hill.

2. Place the cleaned conductors together until approximately 20 cms to 30 cms of the ends overlap each other for the smaller sizes and 30 cms to 45 cms for larger sizes.
3. Place splicing clamps (known as connectors) on the two wires about 10 cms from the end of the wire. See that connectors should grip both the wires firmly. The wires should not be allowed to slip or turn in the connectors otherwise, a 'burned' wire will result and one of the conductors will eventually break at that point.
4. Do twisting from both ends i.e. wrap each wire about the other wire. The usual number of turns to be made is four. (see fig. 1) . More number of turns may burn the wire while less number of turns may give away and the wires crawl apart.
5. Shift both connectors on to the twisted portion of the wires. Shift required will be equal to the width of the connector.
6. With a pair of pliers, finish the splice by serving up the ends. Finishing is done by wrapping the loose ends of the wire about the conductors. 3 or 4 turns are the usual number. These turns are known as 'buttons'.
7. After the buttons are on, the ends should be cut close to the splice.
8. Solder well the splice so made.
9. Wrap with four layers of friction tape and paint with compound if covered wires are used.

b) Making a sleeve joint:

Medium-size line conductors are best joined by means of the so-called splicing sleeve which is a special connection that ensures good electrical and mechanical joints. The sleeve itself is a piece of single or double tubing. To make a sleeve joint, proceed as below:

1. Scrap both ends of the wires clean and bright.

EXPERIMENT/PRACTICAL NO: 53

TITLE OF EXPERIMENT/PRACTICAL:

Practice of joining overhead line conductors.

SPECIFIC OBJECTIVES:

1. To give acquaintance with the different types of line joints
2. To impart know how of joining the line conductors.
3. To give knowledge regarding which type of joint to be used in what type of situation.

INTRODUCTORY INFORMATION AND RALATED THEORY:

Lind joints can be divided into four classes: splices, sleeve joints, compression joints, and automatic aplices. Splicing is suitable for small-sized copper wires, but the larger sizes of hard drawn copper wire as well as aluminium are usually joined by means of splicing sleeves or compression joints.
In field, the common practice is to use sleeve joints and compression joints to join overhead line conductors.

EQUIPMENT AND MATERIALS:

1. Line conductor to joined.
2. Splicing clamps (connectors)
3. Cleaning material.
4. Pliers
5. Soldering equipment
6. Sleeves twisters.
7. Compression die.
8. Sleeves.
9. Friction tape e.g. empirale tape etc.

Diagram:

(see attached sheet)

PROCEDURE: a) Making a splice:

1. Scrap two ends of wire to be spliced perfectly clean and free from insulation in case of covered wires. The wires should be clean until bright. Remove all rougu or high spots.

2. Run wires through sleeves, allowing the ends to portude i.e. ends of the wires should project several inches beyond the ends of the sleeve.
3. Bend these wires with the pliers. This bending keeps them from slipping out of the sleeve.
4. Make three and a half turns with sleeve twisters one on each end. Twist lightly.
5. Cut off joints and the joint is completed.

Sleeves should always be made of the same kind of material as the conductor they are to be used with.

c) Making a compression joint:

A compression joint also makes use of sleeve. Instead of twisting the sleeve, however, the sleeve is compressed with great force onto the conductor. The use of a die in compression makes the sleeve grip the conductor firmly.

The order of steps for making a compression joint are as below:

1. Clean the conductor ends thoroughly. All dirt and grease should be removed with gasoline or similar cleaning solvent. When a conductor that has been in series is being spliced, special care should be taken to remove oxidation on that portion which is inserted in the sleeve.
2. Match the size of splicing sleeve to the size of the conductor.
3. The die number must be matched to the Sleeve number.
4. The conductor ends must be properly centred in the sleeve.
5. The specified number of indents must be made.
6. The joint is ready (see fig. 2) .

TABULAR RECORD OF OBSERVATIONS :

While making these joints, the trainee should make his own report and submit.

PRECAUTIONS

1. Ends of the wires must be cleaned until they are bright. All rought or high spots be removed.

2. Connectors should grip ends of wire properly.

3. Only required number of turns be used in twisting.

4. Shift of connectors be equal to width of connector.

5. Proper soldering be done in careful way.

6. Finishing be done carefully be using pliers.

QUESTIONS FOR EVALUATION:

1. Why cleaning should be done of the ends of the wire to be joined.

2. What happens if connectors do not grip the wires firmly ?

3. Name three methods of joining line conductors.

4. What happens if there is burned wire ?

5. What should be overlapping distance between conductors to be joined ?

6. How much twisting be done ?

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] SPLICING

SLEEVE

APPENDIX - I

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APPENDIX -III

Questionnarie for Collecting Opinion of
Teachers and Students
on the
Instructional-cum-Practical Manual
On
LINEMAN PRACTICE

for

Lineman Vocation Class -XI

(Experimental Edition)

1 9 8 4

DEPARTMENT OF VOCATIONALIZATION OF EDUCATION

NATIONAL COUNCIL OF EDUCATIONAL RESEARCH & TRAINING

SRI AUROBINDO MARG., NEW DELHI -110016.

Dear Teacher/Student,

We are happy to place this Manual at your disposal with the hope that it will help you to conduct the practical works prescribed in the syllabi and to gain required competencies through vocational expertise.

This Manual conforms to the syllabi of Lineman Vocation Class-XI offered by the State of Haryana and includes most of the important activities to be performed by a Lineman. This is an experimental edition with ample scope for further improvement of the Manual.

After having used this Manual for a year or more, kindly read the appended questionnarie carefully and write down the answers precisely and exactly to the point. You may use additional sheets of paper, if the space provided is insufficient. The questionnarie may be mailed at the following address:

Shri Sachchidananda Ray
Programme Co-ordinator, Deptt. of
Vocationalization of Education
National Council of Educational
Research & Training
Sri Aurobindo Marg
NEW DELHI -110016.

QUESTIONNAIRE FOR THE TEACHERS

LABORATORY MANUAL ON ________________________________

A. Name of the Teacher (In Block Letters) ________________________________

B. Name and Postal address of the Institution ________________________________

____

____

C. i) Qualification ________________________________

ii) Teaching Experience ________________________________

iii) Professional/Field/Industrial experience ________________________________

1. Do the experimental activities covered in the Manual develop desired skills in the students ?

Yes/No

2. List the experimental activities included in the Manual which do not figure in the syllabus ?

3. List the experimental activities included in the Manual which do not figure in the syllabus, but are vocationally important.

4. List the experimental activities prescribed in the syllabus but not covered in the Manual.

5. List the vocationally important experimental activities which are neither included in the Manual nor prescribed in the syllabus.

6. a) Does the relevant information given under every experimental activity furnish enough theoretical back ground of the activity.

Yes/No

b) If not, list the experiments where relevant information needs further modification.

Experiment No	Portion	Type of modification needed

7. a) Does the relevant information contain any factual errors or inaccuracies ?

Yes/No

b) If any, give details

Experiment No	Error/Inaccuracy	Should read as

8. Did you come across any expressions/sentences in the Manual which do not carry precise meaning or information ? If Yes, then give the details.

Page No.	Expression/Sentence	Would be more appropriate

9. Are the instructional objectives pertaining to each experimental activity rational ? If not, list down the irrational, irrelevant or vague ones.

Experiment No.	Irrational/Vague Objectives

10. Does accomplishment of the experiments result in realisation of the objectives .

Yes/No

11. Could you suggest any improvement in the presentation of the experiments along with your observations ?

Experiment NO	Observations

12. Are the illustrations adequate ?

Yes/No

13. Are there any inaccuracies in the illustrations/ diagrammes given in the Manual ? If yes please point them out.

Illustration No	Discrepancy/Inaccuracy

14. Please give your over all opinion about the Manual which may be useful in the effective improvement of the future editions.

QUESTIONNAIRE FOR THE STUDENTS.

LABORATORY MANUAL OF ____

A. Name of the Student (In Block letters) ____

B. Name and address of the school/college ____

____

C. Class ____

D. Medium of Instruction ____

1. List out the portions of the manual which you found difficult to understand and give reasons.

Experiment No.	Portion of the Text	Difficulty experienced

2. Mention the places where you found the language difficult to understand

Experiment No.	Page No.	Difficulty experienced

3. Point out the figures/illustrations which do not help in understanding the topic/theme.

Illustration No	Your observations/Difficulty experienced

4. Can you conduct the experiments your self with the help of this manual

Yes/No

If not, point out the portions of activity units which need further elaboration or explanation.

Experiment No	Portion to be elaborated

5. Was the theoretical portion given in the Manual useful to you in understanding the why of the experiment ?

Yes/No

6. Do you now understand the scientific reasons behind the steps you have taken in conducting various experiments ?

7. Yours overall opinion about the Manual